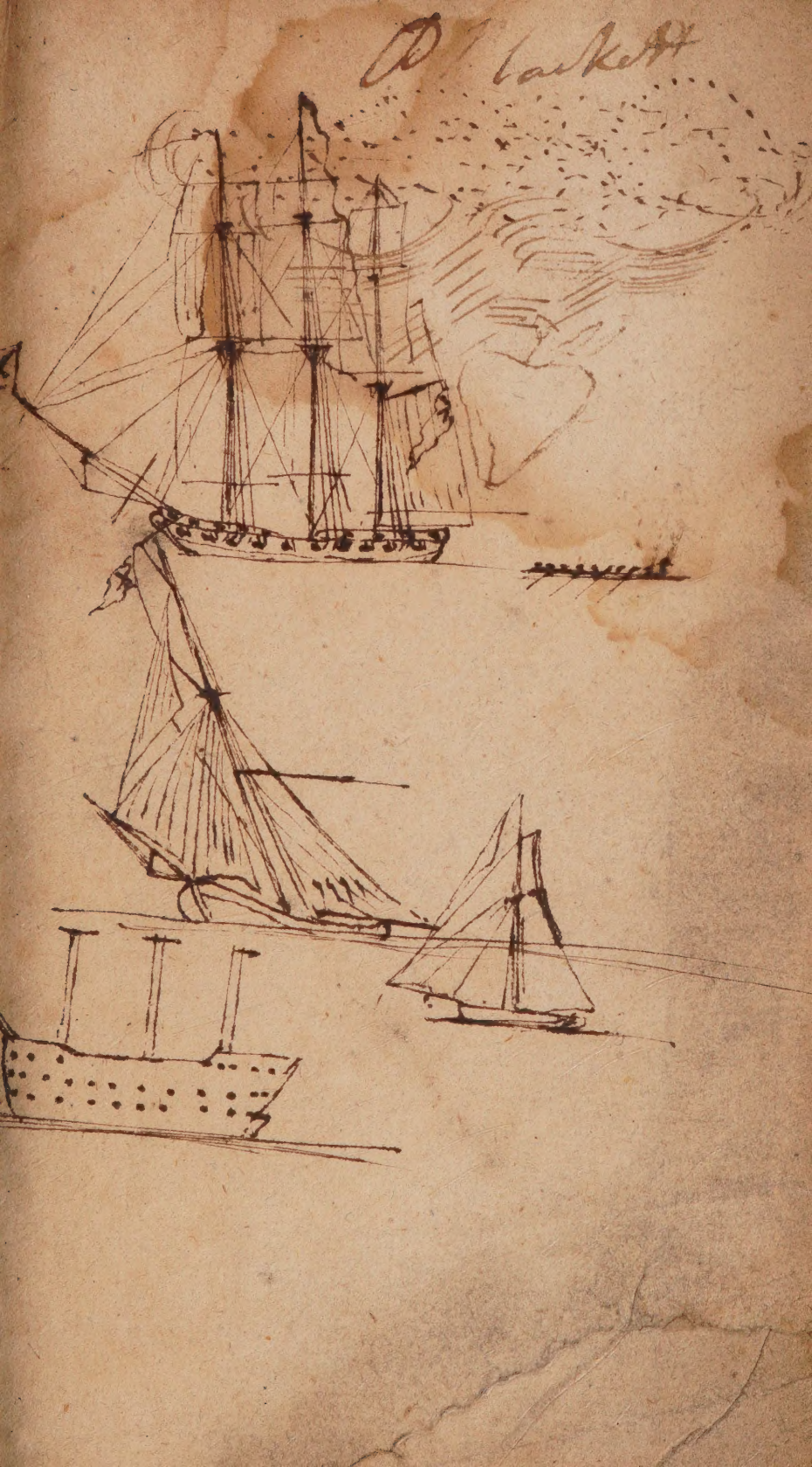

THE

ANATOMY

OF THE

HUMAN BONES, NERVES,

AND

LACTEAL SAC and DUCT.

The TENTH EDITION.

By ALEXANDER MONRO, Senior, M. D. and F. R. S. Fellow of the Royal College of Physicians, and Professor of Medicine and Anatomy in the University of Edinburgh.

DUBLIN:

Printed for W. WHITESTONE, J. POTTS, B. CORCORAN, J. HOEY, J. WILLIAMS, W. COLLES, W. WILSON, T. WALKER, T. WILKINSON, T. ARMITAGE, E. CROSS, C. JENKIN, W. GILBERT, R. MONCRIEFFE, W. SPOTSWOOD, P. WOGAN, L. WHITE, J. BEATTY and C. TALBOT.

M.DCC.LXXVI.

TO THE

STUDENTS of ANATOMY

IN THE

Univerſity of EDINBURGH.

GENTLEMEN,

WHEN this *Oſteology* was firſt printed in 1726, I did not know that Albinus, Winſlow, and Palfyn, were to publiſh deſcriptions of the bones; otherwiſe my papers probably would have remained yet undelivered to the printers. I however flatter myſelf, that this *eſſay* has been of uſe to the gentlemen who did me the honour to attend my lectures, by aſſiſting them to underſtand my ſenſe and repreſentation of things in this fundamental part of anatomy; and that it has poſſibly been of more advantage to them than a more compleat work from an abler hand, unleſs my demonſtrations had been in the order and method of ſuch an author.

This view of your improvement, Gentlemen, is a prevailing argument with me to cauſe this eſſay to be reprinted; and you cannot reaſonably blame me, if I likewiſe acknowledge another motive for it, which more particularly relates to myſelf. In a new edition an author has an opportunity of making his works more correct, compleat, and conſequently acceptable to the public, who may perhaps be indulgent enough to think this little treatiſe not altogether uſeleſs; ſince more reaſoning on the ſtructure and morbid *phænomena* of bones is to be found in it, than in the other writers, who have confined themſelves almoſt entirely to the deſcriptive or proper anatomical part of the *oſteology*.

I have here kept to the plan of the former editions, by firſt conſidering, in the order that ſeemed to me moſt natural and methodical, every thing which I thought neceſſary to be known concerning bones in general; and, in the ſecond part, I have deſcribed the ſeveral bones compoſing the ſkeleton.

The

The bones of adults are what I principally endeavour to deſcribe; but I have added as much of the *oſteogenea* as I think ſerviceable in the practice of phyſic and ſurgery.

That little might be omitted of what was formerly done on this ſubject, I have taken all the aſſiſtance I could from books; but have never aſſerted any anatomical fact on their authority, without conſulting nature, from which all the deſcriptions are made; and therefore the quotations from ſuch books ſerve only to do juſtice to the authors, who have remarked any thing in the ſtructure of the parts that was commonly omitted, and to initiate you in the hiſtory of anatomy; which I once propoſed to make complete, ſo far as related to this ſubject: But not being able to procure ſeveral books, and being ſenſible how many more may have never come to my knowledge, I laid aſide this deſign, of purpoſe omitted many I could have inſerted, and in ſome places I have changed an older author for a later one, who has more fully or clearly deſcribed what I treated of. Beſide anatomiſts, I have alſo na-

med ſeveral other authors to confirm my reaſoning by practical caſes; of which it is not to be ſuppoſed my own experience could furniſh a ſufficient variety.

You will readily obſerve, that I quote no paſſages with a view to criticiſe or condemn them. This precaution of giving no offence, is very neceſſary in thoſe who are ſufficiently conſcious of their being liable to lay themſelves open to juſt cenſure; and it prevents occaſions of uſeleſs wrangling, in which generally both parties are loſers, and the public has little advantage.

In this treatiſe I always make uſe of the moſt common name of each part, and have put the ſynonimous names to be met with in books at the foot of the page, that the reading might be ſmoother, and you might conſult them at your leiſure to aſſiſt you in underſtanding different authors.

The deſcriptions and reaſoning are here blended, without which I always find young anatomiſts are ſoon diſguſted with authors: Their imaginations cannot follow a long chain of deſcriptions, eſpecially when they are not taught

taught at the ſame time the uſes which the deſcribed parts ſerve: Their minds muſt have ſome relaxation, by a mixture of reaſoning, which never miſſes to ſtrike the fancy agreeably, and raiſes a ſtrong deſire to underſtand the principles on which it depends.

The *phænomena* of diſeaſes are all deduced in this eſſay from the ſtructure of the parts, by way of corollaries and queſtions; which ſuch an anatomical work confined me to. And this method has otherwiſe a good effect: For, when one meets with an uſeful propoſition, and is obliged to employ a little thought to find out its ſolution, the impreſſion it makes is deeper, and he acquires a fondneſs for it, as being in part his own diſcovery. My pupils have frequently aſſured me, that they could, with very ſmall reflection, trace out the whole reaſoning from which my concluſions were drawn; I hope their ſucceſſors will alſo think this an agreeable manner of being inſtructed.

Thoſe gentlemen who deſired I would add the lectures which I pronounced in my colleges as a commentary upon the text, where the diſeaſes are mention-

ed, will, I perſuade myſelf, excuſe me for not complying with their deſire, when they conſider the deſign of this is to be a ſchool-book, and how great the difference is between inſtructing youth in private, and pretending to inform the public. *Art.* xxiv. *vol.* v. of Medical Eſſays and Obſervations, publiſhed in this place, is one of theſe lectures which I gave as a commentary on the paragraph (*p.* 12.) concerning the different kinds of *caries*.

In this edition, I have corrected the miſtakes and obſcure paſſages which I diſcovered in the former, and in ſome places I have made the deſcriptions more full and exact, aiming all I could to ſhun unneceſſary minuteneſs on the one hand, and a blameable inaccuracy on the other: Whether I have hit that juſt medium, is what you and the public muſt now judge.

I am ſtill of opinion, that figures of the bones would at any rate have been unneceſſary in a book that is intended to be illuſtrated and explained by the originals themſelves; but would be much more ſo now, when my late ingenious friend Mr. Cheſelden, Dr. Albinus,

nus, and Mr. Sue (*a*), have publiſhed ſuch elegant ones.

You have advantageous opportunities in this place of ſtudying all parts of medicine, under the profeſſors of its different branches in the Univerſity, and of ſeeing the practice of pharmacy, ſurgery, and phyſic, with our ſurgeon-apothecaries, and in the Royal Infirmary, where the diſeaſed poor are carefully treated. Theſe your intereſt, and, I hope, your inclinations, will lead you, Gentlemen, ſo to improve, as that they may become the happy means of your making a conſiderable figure in your ſeveral ſtations. Whatever aſſiſtance is in my power towards ſuch a deſirable event, ſhall be given with the greateſt pleaſure by

Your humble ſervant,

ALEX^R. MONRO.

(*a*) Traitè d'oſteologie, traduit de l'Anglois de M. MONRO, ſeconde partie.

THE

ANATOMY

OF THE

HUMAN BONES.

PART I.

Of the BONES in general.

BONES are covered by a membrane, named on that account PERIOSTEUM*, which is ſo neceſſary to them, that we muſt examine its texture and uſes, before we can underſtand their ſtructure.

The *perioſteum*, as well as moſt other membranes, can be divided into *layers* of fibres. The *exterior* ones, compoſed of the fibres of the muſcles connected to the bones, vary in their number, ſize, and direction, and conſequently occaſion a very great difference in the thickneſs and ſtrength of the *perioſteum* of different bones, and even of the different parts of the ſame bone. The *internal* layer is every where

* Membrana circumoſſalis, omentum oſſibus impoſitum.

where nearly of a ſimilar ſtructure, and has its fibres in the ſame direction with thoſe of the bone to which they are contiguous. Ought not then the name *perioſteum* to be applied, ſtrictly ſpeaking, only to this internal layer, to which the others are joined in an uncertain manner and number?

Some authors *(a)* endeavour to prove the internal layer of fibres of the *perioſteum* to be derived from the *dura mater:* For, ſay they, ſince the membrane covering the ſcull is plainly a production or continuation of the *dura mater,* which paſſes out between the ſutures; and ſince there are muſcles on the head, as well as in other parts, which might furniſh a *perioſteum,* it is needleſs to aſſign different origins to membranes which have the ſame texture and uſes. They add further, in proof of this doctrine, that the *perioſteum* extends itſelf along the ligaments of the articulations from one bone to another; and therefore is continued from its origin over all the bones of the body.—While anatomiſts were fond of the hypotheſis of all membranes being derived from one or other of the two that cover the brain, a diſpute of this kind might be thought of conſequence: But now that the hypotheſis is neglected as uſeleſs, it is needleſs to examine the arguments for or againſt it.

Except where muſcles, cartilages, or ligaments are inſerted into the *perioſteum,* its external ſurface is connected to the ſurrounding parts by thin cellular membranes, which can eaſily be ſtretched conſiderably, but ſhorten themſelves whenever the ſtretching force is removed

(a) Havers, Oſteolog. nov. diſc. 1. p. 16.

moved. When theſe membranes are cut off or broken, they collapſe into ſuch a ſmall ſpace, that the ſurface of the *perioſteum* ſeems ſmooth and equal.

When we attempt to tear off the *perioſteum* from bones, we ſee a great number of white threads produced from the membrane into them; and, after a ſucceſsful injection of the arteries with a red-liquor, numerous veſſels are not only ſeen on the *perioſteum (a)* but moſt of the fibres ſent from the membrane to the bone, ſhew themſelves to be veſſels entering it, with the injected liquor in them; and when they are broken, by tearing off the *perioſteum*, the ſurface of the bone is almoſt covered with red points.

The veins correſponding to theſe arteries are ſometimes to be ſeen in ſubjects that die with their veſſels full of blood; though ſuch numerous ramifications of them, as of the arteries, can ſeldom be demonſtrated, becauſe few of them naturally contain coloured liquors, and ſuch liquors can difficultly be injected into them. This however is ſometimes done *(b)*.

The great ſenſibility of the *perioſteum* in the deep-ſeated ſpecies of *paronychia*, in *exoſtoſes*, *nodi*, *tophi*, and *gummata*, from a *lues venerea*, or whenever this membrane is in an inflamed ſtate, is a ſufficient proof that it is well provided with nerves, though they are perhaps too ſmall to be traced upon it; and therefore one cannot

(*a*) Ruyſch. Epiſt. 5. tab. 5. fig. 1. 2. epiſt. 8. tab. 9. fig. 1. 9.

(*b*) Sue traité d'oſteologie traduit de l'Anglois de Mr. Monro. Note in page 9.

cannot well determine, whether they are ſent along with the arteries in the common way, or are derived from the tendinous fibres of the muſcles expanded on the *perioſteum (a)*.

Veſſels alſo paſs through the *perioſteum* to the marrow; of which more hereafter. And frequently muſcles, ligaments, or cartilages, pierce through the *perioſteum*, to be inſerted into the bones.

The chief uſes of the *perioſteum* are: 1. To allow the muſcles, when they contract or are ſtretched, to move and ſlide eaſily upon the bones; the ſmooth ſurface of this membrane preventing any ill effects of their friction upon each other. 2. To keep in due order, and to ſupport the veſſels in their paſſage to the bones. 3. By being firmly braced on the bones, to aſſiſt in ſetting limits to their increaſe, and to check their overgrowth. 4. To ſtrengthen the conjunction of the bones with their *epiphyſes*, ligaments, and cartilages, which are eaſily ſeparated in young creatures, when this membrane is taken away. 5. To afford convenient origin and inſertion to ſeveral muſcles which are fixed to this membrane. And, laſtly, to warn us when any injury is offered to the part it covers; which, being inſenſible, might otherwiſe be deſtroyed without our knowledge, or endeavouring to procure a remedy.

When

(*a*) See the diſpute about the ſenſibility of this and of other membranes in Zimmerman. Diſſert. de irritabilit.—Act Gotting, vol. 2.—Haller ſur la nature ſenſible et irritable.—Whytt's phyſiolog. eſſay II.—Remar. Diſſert. de fungo articulor. § 26. 34.

When the cellular ſubſtance connecting the *perioſteum* to the ſurrounding parts is deſtroyed, theſe parts are fixed to that membrane, and loſe the ſliding motion they had upon it; as we ſee daily in iſſues, or any other tedious ſuppurations near a bone.—When the veſſels which go from the *perioſteum* to the bones are broken or eroded, a collection of liquor is made between them, which produces a ſordid ulcer or rotten bone. This often is the caſe after fractures of bones, and inflammations of the *perioſteum*, or after *ſmall-pox*, *meaſles*, *ſpotted fevers*, and *eryſipelas*.—Do not the diſorders of the *perioſteum*, coming rather along with or ſoon after the cutaneous than other diſeaſes, indicate ſome ſimilarity of ſtructure in the *perioſteum* and ſkin?

The bones are the moſt hard and ſolid parts of the body, and, as all other parts where large veſſels do not enter, are generally of a white colour; only in a living creature they are blueiſh, which is owing to the blood in the ſmall veſſels under their ſurface. The leſs therefore and fewer the veſſels are, and the thicker and firmer the bony ſurface covering the veſſels is, the bones are whiter. Hence the bones of adults are whither than thoſe of children; and, in both young and old, the white colour of different bones, or of the ſeveral parts of the ſame bone, is always in proportion to their veſſels and ſolidities; which circumſtances ought to be regarded by ſurgeons, when they are to judge of the condition of bones laid bare.

Bones are compoſed of a great many *plates**, each of which is made up of fibres of ſtrings united by ſmaller fibrils *(a)*; which being irregularly diſpoſed, and interwoven with the other larger fibres, make a reticular work.—— This texture is plainly ſeen in the bones of fœtuſes, which have not their parts cloſely compacted, and in the bones of adults which have been burnt, long expoſed to the weather, or whoſe compoſition has been made looſe by diſeaſes.—The chinks which are generally made according to the direction of the larger fibres of bones that have undergone the action of fire, or of the weather, ſhew the greater ſtrength of theſe than of the fibres which connect them.—Numerous accurate obſervations of the different times in which exfoliations are made from the ſides or ends of ſimilar bones, might bid fair to determine what is the proportional force of coheſion in the two ſorts of fibres.

The plates are ſaid *(b)* to be firmly joined to each other by a great number of *claviculi*, or ſmall bony proceſſes, which, riſing from the inner plates, pierce through ſome, and are fixed into the more external ones. Of theſe nails, four kinds, *viz. the perpendicular*, *oblique*, *headed*, and *crooked*, have been deſcribed: But in bones fitly prepared, I could only ſee numerous irregular proceſſes riſing out from the plates *(c)*.

Though the exterior part of bones is compoſed of firm compact plates, yet they are all more

* Squamæ, bracteæ, laminæ.

(a) Malpigh. Anat. plant. & oper. poſthum.

(b) Gagliard. Anat. oſſium nov. invent. illuſtrat. cap. 1. obſ. 2.

(c) Malpigh. oper. poſthum.

more or leſs cavernous internally. In ſome (*e.g.* middle thin part of the *ſcapula* and *os ilium*) the ſolid ſides are brought ſo near, that little cavity can be ſeen; and in others (middle of *os humeri*, *femoris*, &c.) the cavities are ſo large, that ſuch bones are generally eſteemed to be hollow or fiſtular. But the internal ſpongy texture is evident in young animals; and ſome of it may be ſeen to remain in thoſe of greateſt age, when bones are cautiouſly opened, after they have been kept ſo long as to be free of the oil they contain, or after being burnt.

This ſpongy cavernous internal part of bones, is generally called their *cancelli* or LATTICE-WORK, and is formed in the following manner. The plates are firmly joined about the middle of the bone; but as they are extended towards its end, the more internal plates ſeparate from the exterior, and ſtretch out their fibres towards the axis of the bone, where they are interwoven with the fibres of other plates that have been ſent off in the ſame way. Seeing the plates are thus conſtantly going off, the ſolid ſides of the bones muſt become thinner, and the lattice-work muſt be thicker and ſtronger towards their ends. This is evident in many of them, where the ſolid ſides of their middle are very thick, and the *cancelli* are ſcarce obſervable; whereas, at the ends, where their diameter is greateſt, the ſolid walls or ſides are not thicker than paper, and the *cancelli* are numerous and large enough to fill up the whole ſpace left between the ſides.

The twiſting and windings which theſe *cancelli* make, and the interſtices which they leave, differ

differ conſiderably in figure, number, and ſize; and therefore form little cells, which are as different, but communicate with each other. Some writers (*a*) minutely remark theſe different appearances of the *cancelli*, after they begin to ſeparate from the plates; and from thence diſtinguiſh them into *wrinkled*, *perforated*, and *net-like*.

The *cancelli* ſuſtain the membranous bags of the marrow which are ſtretched upon them, and thereby hinder theſe membranous parts to be torn or removed out of their proper places, in the violent motions and different poſtures which the bones are employed in. This ſupport which the *cancelli* afford the marrow, alſo ſaves its membranes and veſſels, in the lower parts of the bones, from being compreſſed by the weight of the marrow above.

The depreſſions between the fibres of the external plates of bones appear like ſo many furrows on their ſurface, into each of which the *perioſteum* enters; by which the ſurface of contact, conſequently the coheſion, between it and the bone, is conſiderably increaſed, and a greater number of veſſels is ſent from it into the bone, than if it was a plain ſurface.

Both on the ridges and furrows, numerous little pits or orifices of canals are to be ſeen, by which the veſſels paſs to and from the bones.

After a ſucceſsful injection, the arteries can be traced in their courſe from the pits to the plates and fibres; and, in ſawing, cutting, or raſping the bones of living creatures, theſe veſſels diſcover themſelves, by the ſmall drops of blood

(*a*) Gagliard. Anat. offium, cap. 1. obſ. 4, 5, 6, 7.

blood which then ouze out from the moſt ſolid part of the bones. But the cleareſt demonſtration of the intimate diſtribution of theſe ſmall arteries, is, to obſerve the effect of ſuch a tinging ſubſtance as can retain its colour, when ſwallowed, digeſted, and mixed with the blood of any living animal, and at the ſame time has particles ſmall enough to be conveyed into the veſſels of the bones; ſuch is *rubia tinctorum*, madder root (*a*): For we ſee the gradual advances which this tincture makes from the *perioſteum* into the more internal parts of the bones, and how univerſally the diſtribution of the liquors is made, the whole bony ſubſtance being tinged. Whether the time in which this tinged liquor paſſes from the outer to the internal plates, till all the plates are made of its colour, and the time which the diſappearing of the dye, after giving the creature no more of this ſort of food, makes us think it takes to return, are the ſame in which the natural liquors circulate, is uncertain; becauſe this tinging ſubſtance may move more ſlowly, or may paſs more quickly, than the natural liquors do. ——The arteries are larger near each end than at the middle of the large bones that are much moved; becauſe they not only ſerve the bony plates near the ends, but paſs through them to the marrow.—As animals advance in age, the arteries of the bones become leſs capacious; as is evident, 1. From the bones of adults having leſs blood in them than thoſe of children have.

2. From

(*a*) Philoſoph. tranſact. num. 442. art. 8. num. 443. art. 2. num. 457. art. 4.——Mem. de l'acad. des ſciences. 1739, 1742.

2. From many of them becoming incapable in old age of admitting the coloured powders uſed in injections, which eaſily paſs in youth. And, 3. From the bones of old creatures being more difficultly tinged with madder than thoſe of young ones.—If authors have not miſtaken, the arteries of bones have ſometimes become very large (*a*).

We may conclude from arteries being accompanied with veins ſo far as we can trace them in every other part of the body, that there are alſo veins in the bones; and the diſappearing of the tincture of *madder*, after bones of living animals are coloured with it, could not be without ſuch veins to carry it away; nay, the veins of bones can ſometimes be injected and then ſeen (*b*).

The bones of a living animal are ſo inſenſible, that they can be cut, raſped, or burnt, without putting the creature to pain, and the nerves diſtributed in their ſubſtance cannot be ſhewn by diſſection; from which it might be inferred that they have no nerves diſtributed to them: But the general tenor of nature, which beſtows nerves to all the other parts, ſhould prevent our drawing ſuch a concluſion. And if ſenſibility is a ſure proof of nerves entering into the compoſition of any part, as it is generally allowed to be, we have ſufficient evidence of nerves here in the bones; for the granulated red fleſh which ſprouts out from them, after an amputation of a limb, or performing the operation

(*a*) Diemerbroek. Anat. lib. 9. cap. 1.——Mery. Hiſt. de l'acad. des ſciences, 1704.

(*b*) Sue trad. d'oſteolog, p. 9.

peration of the *trepan*, or after an *exfoliation*, is exquiſitely ſenſible: And, in ſome ulcers of bones, where the *perioſteum* was all ſeparated, the patient ſuffered racking pain, if the bone was touched with a rough inſtrument; nor was he free of pain after the bone was perforated (*a*)——The reaſon why the nerves of rigid hard bones become inſenſible, is, That all nerves muſt have a conſiderable degree of flexibility at that part where objects are applied, otherwiſe it cannot be affected by their impreſſions. We ſee this illuſtrated in a very common analogous caſe, the growth of a new nail: When the former one has ſuppurated off, the thin membrane which firſt appears, is exquiſitely ſenſible; but gradually becomes dull in its ſenſation, till it can be cut or ſcraped, without cauſing pain, after it is formed into a hard nail.

From what has been ſaid of the veſſels of bones, it is evident, that there is a conſtant circulation of fluids in every part of them; and that there is a perpetual waſte and renewal of the particles which compoſe the ſolid fibres of bones, as well as of other parts of the body; the addition from the fluids exceeding the waſte during the growth of the bones; the renewal and waſte keeping pretty near *par* in adult middle age; and the waſte exceeding the ſupply from the liquors in old age; as is demonſtrable from their weight: For each bone increaſes in weight, as a perſon approaches to maturity; continues of nearly the ſame weight till old age begins, and then becomes lighter. ——The ſpecific gravity of the ſolid ſides, on the

(*a*) Nicol. Maſſa, lib. introd. anat. cap. 30.

the contrary, increaſes by age; for then they become more hard, compact, and denſe. In conſequence of this, the bones of old people are thinner and firmer in their ſides, and have larger cavities than thoſe of young perſons.

The vaſcular texture of bones muſt make them ſubject to *obſtructions*, *ecchymoſes*, *ulcers*, *gangrenes*, and moſt other diſeaſes which the ſofter parts are affected with; and therefore there may be a greater variety of *caries* than is commonly deſcribed (*a*).

Hence we can account for the following appearances.

Hæmorrhages from fungous fleſh riſing out from the moſt ſolid part of a cut bone (*b*).

The regular alternate elevation and ſubſiding, or apparent pulſation, frequently to be ſeen in ſome of the cells of a carious bone.

Cells reſembling *cancelli*, ſometimes ſeen in the part of a bone, which, in a natural ſtate, is the moſt ſolid and firm (*c*).

A bone as a tube including another bone within it (*d*).

On the internal ſurface of the ſolid parts of bones, there are orifices of canals, which paſs outwards through the plates to open into other canals that are in a longitudinal direction, from which other *tranverſe* paſſages go out to terminate in other *longitudinal* canals; and this ſtructure is continued through the whole ſubſtance of bones, both theſe kinds of canals becoming ſmaller

(*a*) Edinburgh Medical eſſays and obſ. vol. 5. art. 25.
(*b*) Medical eſſay, vol. 4. art. 21.
(*c*) Ruyſch Theſ. 8. num. 8. Theſ. 10. num. 176.
(*d*) Idem, Ibid.

ſmaller gradually as they approach the outer ſurface (*a*).—Theſe canals are to be ſeen to the beſt advantage in a bone burnt till it is white: When it is broken tranſverſely, the orifices of the *longitudinal* canals are in view; and when we ſeparate the plates, the *tranſverſe* ones are to be obſerved. Here however we are in danger of believing both theſe ſorts of canals more numerous than they really are; becauſe the holes made by the proceſſes connecting the plates of bones have the appearance of the *tranſverſe* (*b*), and the paſſages for the blood-veſſels reſemble the *longitudinal* canals. I don't know how we are to keep free of error about the *tranſverſe* canals; but think we may diſtinguiſh between the two kinds of *longitudinal* ones; for the paſſages of the veſſels are largeſt near the external ſurface of the bone, and every tranſverſe ſection of them is circular; whereas the *longitudinal canals* are largeſt near the *cancelli*, and their tranverſe ſections appear to me of a flat oval figure, which may be owing to the different *momentum* of the fluids conveyed in them.—The ſituation of the larger longitudinal canals, and of the paſſages of the larger veſſels, makes a bone appear more denſe and compact in the middle of its ſolid ſides, than towards its outer and inner ſurfaces, where it is ſpongy.

We ſee marrow contained in the larger tranſverſe and longitudinal canals juſt now deſcribed, and from thence judge that it paſſes alſo

(*a*) Havers Oſteolog. nov. p. 43.
(*b*) Morgagn. Adverſ. 2. animad. 25.

alſo into the ſmaller ones. The drops of oil which we diſcover with a microſcope every where on the ſurface of a recent bone fractured tranſverſely, and the ouſing of oil through the moſt ſolid bone of a ſkeleton, which renders them greaſy and yellow, are a confirmation of the uſe of theſe canals. Of what advantage this diſtribution of the marrow thro' the ſubſtance of bones is, will be mentioned when the nature and uſe of this animal oil is inquired into.

Moſt bones have one or more large oblique canals formed through their ſides for the paſſage of the medullary veſſels, which are to be deſcribed afterwards.

Bones expoſed to a ſtrong fire in chemical veſſels, are reſolved, in the ſame manner as the other parts of animals, into *phlegm*, *ſpirit*, *volatile ſalt*, *fetid oil*, and a black *caput mortuum*. But the proportion of theſe principles varies according to the age, ſolidities, and other circumſtances of bones. Young bones yield the largeſt proportion of *phlegm*; ſpongy bones afford moſt *oil*, and ſolid ones give moſt ſalt and black *reſiduum*.—Though this *reſiduum* can ſcarce be changed by the force of fire while it is in cloſe veſſels; yet, when it is burnt in an open fire, the tenacious oil, to which it owes its black colour, is forced away, and a white earth is left that has little or no fixed ſalt in it. This earth ſeems to be the proper conſtituent ſolid part of bones, and the other principles give it firmneſs and tenacity: For the quantity of the earth is ſo great, that, after all the other principles

principles are ſeparated from a bone, its former ſhape and ſize remain (*a*); but it is very brittle till it is moiſtened with water or oil, when it recovers ſome tenacity.—The increaſe of the proportion of earth in old people's bones is one reaſon of their being more brittle than thoſe of young people are.

Leſt any imagine the ſalts and oils of bones, while in a natural ſtate, to be of the ſame acrid kind with thoſe obtained from them by the chemical analyſis, it is to be obſerved, that theſe principles may be extracted from bones in the form of a very mild jelly, by boiling them in water.

The bones ſuſtain and defend the other parts of the body.

Bones are lined within, as well as covered externally, with a membrane; which is therefore commonly called PERIOSTEUM INTERNUM.

The *internal perioſteum* is an extremely fine membrane; nay frequently it has a looſe reticular texture; and therefore it is compared by ſome to the *arachnoid* coat of the ſpinal marrow: ſo that we cannot expect to divide it into layers as we can divide the *external perioſteum*. We can however obſerve its proceſſes entering into the tranſverſe pores of the bones, where probably they are continued to form the immediate canals for the marrow diſtributed through the ſubſtance of the bones; and along with them veſſels are ſent, as from the external *perioſteum*, into the bone (*b*). Theſe proceſſes being

(*a*) Havers Oſteolog. nov. diſc. 1. p. 32.
(*b*) Winſlow Expoſition anat. des os frais, § 82. 83.

being of a very delicate texture, the adhesion of this membrane to the bone is so small, that it separates commonly more easily from the bone than from the marrow which it contains: Wherefore, one might call it the common membrane of the marrow, rather than by the name it now has. But whether one or t'other designation ought to be given it, is not worthy a dispute.

From the internal surface of the internal *periosteum*, a great number of thin membranes are produced; which, passing a-cross the cavity, unite with others of the same kind, and form so many distinct bags, which communicate with each other; and these again are subdivided into communicating vesicular cells, in which the marrow is contained. Hence it is, that the marrow, when hardened, and viewed with a microscope, appears like a cluster of small pearl; and that the hardened marrow of bones buried long under ground, or laid some time in water, and then dried, is granulous (*a*). This texture is much the same with what obtains in the other cellular parts of the body, where fat is collected; only that the cells containing the marrow are smaller than those of the *tunica adiposa* or *cellulosa* elsewhere, which probably is owing to their being inclosed in the bones, where they are not so much stretched or extended as in other parts.

The MARROW is the only part of the blood, separated by small arteries, and deposited in these cells. Its colour and consistence may therefore

(*a*) Ruysch Thesaur. 9. num. 2. et Adverſ. dec. III. obſ. 9.

therefore vary according to the ſtate of the veſſels, and their diſtribution on the membranes of the cells.

The marrow as well as the other fat of the body chemically analized yields, beſides oil and water, a conſiderable proportion of an acid liquor, but no *alcali* (*a*). This may be the reaſon of its being leſs putreſcent than the blood or moſt other parts of animals (*b*), which is a neceſſary quality in a ſubſtance that is conſtantly expoſed to a conſiderable degree of heat, and is more in a ſtagnating condition than the other liquors.

Beſides the arteries, which I mentioned already, *p.* 9. to be ſent from the bones to the marrow, there is at leaſt one artery for each bone; ſeveral bones have more, whoſe principal uſe is to convey and ſecern this oily matter. After theſe arteries have pierced the ſolid ſide of a bone, they are divided into ſeveral branches; which ſoon are diſtributed every where on the internal *perioſteum*, and afterwards ſpread their branches inwards on the medullary cells, and outwards through the tables of the bone.

The blood, which remains after the ſecretion of the marrow, is returned by proper veins, which are collected from the membranes into one or two large trunks, to paſs out at the ſame holes or paſſages at which the artery or arteries enter.

(*a*) Grutzmaker Diſſert. de oſſium medulla.—Haller Element phyſiolog. lib. 4. ſect. 4.

(*b*) Pringle Append. to camp diſeaſes, exper. 47.

The general rule of the ſmall veſſels decreaſing in their capacities as animals advance in age, to which many phænomena in the animal œconomy are owing, obtains here: For tho' the trunks of the medullary veſſels enlarge as animals turn older; yet the ſmall branches become ſmaller; as is evident from injections, which cannot be made to paſs near ſo far in theſe veſſels of adults as of children. Hence the marrow is bloody in children, oily and balmy in middle age, and thin and watery in old people.

By experiments made on the marrow, when bones of living animals are opened or cut thro' (*a*), and from the racking pain with which ſuppurations within bones are frequently attended, we have ſufficient proof that the membranes here are ſenſible, and conſequently have nerves diſtributed to them. *Hippocrates* (*b*) might therefore ſay juſtly, that a wound penetrating into the cavity of a bone may produce a *delirium*.

The veſſels of the marrow, wrapt up in one common coat from the *perioſteum*, paſs thro' the bones by proper canals; the moſt conſiderable of which are about the middle of each bone, and are very oblique. Sometimes theſe veſſels continue at a little diſtance in their paſſage when the canal is divided by a ſmall bony partition or two.

From the ſtructure of the contents of the bones, we may judge how theſe parts, as well as

(*a*) Du Verney, Memoires de l'acad. des ſciences, 1700.
(*b*) Aphoriſm. § 7. aph. 24.

as others, may be ſubject to oidema, phlegmon, eryſipelas, ſchirrhus, &c. and may thence be led to a cure of each, before the common conſequence, putrefaction, takes place, and frequently occaſions the loſs of the limb, if not of the patient.

The marrow is of very conſiderable uſe to the bones; for by entering their tranſverſe canals, and paſſing from them into the longitudinal ones, it is communicated to all the plates, to ſoften and connect their fibres, whereby they are preſerved from becoming too brittle; as we ſee they do in burnt bones, or thoſe long expoſed to the air; in people labouring under old age, pox, or ſcurvy: In all which caſes, the oil is either in too little quantity, or has its natural good qualities changed for worſe ones.

Beſides this advantage which the ſubſtance of bones has from the marrow, their articulations are ſaid *(a)* to receive no leſs benefit from it: for it is thought that the marrow paſſes into the articular cavities, through the holes which are in the bones near the large joints. And, as a proof of this, it is alledged, that butchers, upon ſeeing the greater or leſſer quantity of marrow, in the bones of cows, can tell whether they have travelled far or little before they were ſlaughtered.

When the marrow, after having ſerved the uſes mentioned, is reaſſumed into the maſs of blood, (as it is continually, in common with all other ſecreted liquors that have not paſſa-

(a) Joan de Muralto Vade mecum anat. exercit. 5. § 3. Havers Oſteolog. nov. diſc. 3. p. 179.

ges formed for conveying them out of the body), it corrects the too great acrimony communicated to the ſaline particles of our fluids by their circulation and heat; in the ſame manner as lixivial ſalts are blunted by oil in making ſoap. Hence, in acute diſeaſes, the marrow, as well as the other fat of the body, is quickly waſted, but muſt be immediately ſupplied by liquors from the veſſels; ſeeing the cells within the bones, which have no aſſiſtance to their contraction from the preſſure of the atmoſphere, cannot collapſe, as the *tela cellularis* under the ſkin does, when the liquor in its cells is abſorbed: the bones therefore are always full.

Since it is the nature of all oil to become thin and rancid when expoſed long to heat, and bones have much oil in their firm hard ſubſtance, we may know why an ungrateful ſmell, and dark coloured thin *ichor*, proceed more from corrupted bones than from other parts of the body; and we can underſtand the reaſon of the changes of colour which bones undergo, according to their different degrees of mortification.—Hence likewiſe we may learn the cauſe of a *ſpina ventoſa*, and of the difficulty of curing all *caries* of bones proceeding from an obſtruction, and conſequent putrefaction of the marrow; and of the quick pulſe, thirſt, and *hectic paroxyſms*, ſo often attending theſe diſeaſes. Theſe *phaenomena* alſo teach us the reaſon of the fatal *prognoſis* taken from black fetid urine in fevers.

Though bones ſo far agree in their ſtructure and annexed parts, yet we may obſerve a conſiderable

ſiderable difference among them in their magnitude, figure, ſituation, ſubſtance, connection, uſes, &c. From which authors have taken occaſion to diſtinguiſh them into as many claſſes as they could enumerate of theſe different circumſtances. But theſe being obvious to every perſon that looks on bones, I ſhall only mention one of them; which comprehends very near the whole bones of the body, and at the ſame time leads us to examine the moſt conſiderable variety that is to be found in the diſpoſition of their conſtituent parts, and in their uſes. It is this, that ſome bones are *broad* and *flat*, while others are *long* and *round*.

The *broad* bones have thin ſides, by the plates being ſoon and equally ſent off to form the lattice work; which therefore is thicker, and nearly of an equal form all through. By this ſtructure, they are well adapted to their uſes, of affording a large enough ſurface for the muſcles to riſe from, and move upon, and of defending ſufficiently the parts which they incloſe.

The *round* bones have thick ſtrong walls in the middle, and become very thin towards their ends, which is owing to very few plates ſeparating at their middle; where, on that account, the *cancelli* are ſo fine and ſmall that they are not taken notice of: But ſuch bones are ſaid to have a large reſervoir of oil in this place. Towards their ends the lattice-work becomes very thick, and rather more compleat than in the other ſort of bones.—Theſe round bones having ſtrong forces naturally applied to them,

and being otherwiſe expoſed to violent injuries, have need of a cylindrical figure to reſiſt external preſſure, and of a conſiderable quantity of oil to preſerve them from becoming too brittle. Beſides which, they are advantageouſly provided with thick ſides towards their middle, where the greateſt forces are applied to injure them; while their hollowneſs increaſes their diameter, and conſequently their ſtrength to reſiſt forces applied to break them tranſverſely *(a)*. Thus, for inſtance, in eſtimating the proportional reſiſtance of two cylindrical bones of unequal diameters, but conſiſting of an equal number of ſimilar fibres uniformly diſpoſed round each, it is plain,

1. That the abſolute force of theſe two bones is equal, becauſe they conſiſt of equal numbers of ſimilar fibres.

2. That the abſolute forces of all the fibres in each bone have the ſame effect in reſiſting any power applied to break them, as if the ſum of all their forces was united in the reſpective centers of the tranſverſe ſections where the fractures are to be made. For, by hypotheſis, the fibres being uniformly diſpoſed in each, there is not any fibre in either bone that has not a correſponding fibre; the ſum of both whoſe diſtances from the axis of revolution (about which all the parts of the bone muſt revolve in breaking) is equal to two ſemidiameters of the bone: Conſequently each fibre, and all the fibres, may be regarded as reſiſting at the diſtance of one ſemidiameter or *radius* from this axis, that is, in the center.

3. Since

(*a*) Galilei Mechanic, dialog. 2.

3. Since the united force of all the fibres is to be regarded as reſiſting at a diſtance from the center of motion equal to the ſemidiameter, it follows, that the total reſiſtance of all theſe fibres, or the ſtrength of the bone, is proportional to its ſemidiameter, and conſequently to its diameter.

I have here taken for an example one of the moſt ſimple caſes for calculating the proportional forces of bones. But, was it not too foreign to the preſent deſign, it might be univerſally demonſtrated, that, of whatever figure bones are, and in whatever manner their fibres are diſpoſed, their ſtrength muſt always be in a *ratio*, compounded of the area of their tranſverſe ſections, or of their quantity of bony matter, and of the diſtance of the center of gravity of theſe ſections from the center of motion or fulcrum, on which the bone is ſuppoſed to be broken *(a)*.

Since therefore the ſtrength of bones depends on the number of fibres, or quantity of matter, and the largeneſs of their diameters, one may conclude, that the part of a bone formerly fractured, and reunited by a *callus*, muſt be ſtronger than it was before the fracture happened; becauſe both theſe advantages are obtained by a *callus*; which is a wiſe proviſion, ſince bones are never ſet in ſuch a good direction as they were naturally of; and then wherever a *callus* is formed, there is ſuch an obſtruction of the veſſels, that if the bone was

(a) See the demonſtration of this theorem by Dr. Porterfield in the Edinburgh Medical eſſays, vol. 1. art 10.

again broken in the ſame place, the *oſſific* matter could not ſo eaſily be conveyed to reunite it. This *callus* may indeed, for want of compreſſion, be allowed to form into a ſpongy cellular ſubſtance (*a*); but even in this caſe the ſtrength of the bone is here increaſed by one or both the cauſes above-mentioned.

Many bones have protuberances, or *proceſſes* *, riſing out from them. If a *proceſs* ſtands out in a roundiſh ball, it is called *caput*, or *head*.—If the head is flatted, it obtains the appellation of *condyle*.——A rough unequal protuberance, is called *tuberoſity*.——When a *proceſs* riſes narrow, and then becomes large, the narrow or ſmall part is named *cervix*, or *neck*.———Long ridges of bones, are called *ſpines*.———Such proceſſes as terminate in a ſharp point, have the general name of *coronæ*†, or *coronoid*, beſtowed on them, though moſt of them receive particular names from the reſemblance thay have, or are imagined to have, to other ſubſtances, *e. g. maſtoid*, *ſtyloid*, *anchoroid*, *coracoid*, *ſpinal*, *&c.*—Such proceſſes as form brims of cavities, are called *ſupercilia* ‡.

Proceſſes ſerve for the advantageous origin and inſertion of muſcles, and render the articulations firm and ſtable.

Before

(*a*) Ruyſch. Theſaur. 8. n. 49. Muſ. anat. thec. B. repoſit, 2 n. 2.

* Ἀπόφυσεις, ἔκφυσεις ἐξοχὴ, πρόβολὴ, πρόβλημα, Exceſſus, explanatio, tuberculum, gibbus, eminentia, productio, extuberantia, projectura, enaſcentia.

† Roſtra glandes.

‡ Ὑτυες, ὄφρυες, ἄμβονες, χείλη, Labra.

Before leaving this ſubject, we muſt remark, that much the greater number of what are called proceſſes in adult bones, diſcover themſelves in children to be *epiphyſes*, or diſtinct bones, which are afterwards united to the other parts; ſuch are the *ſtyloid* proceſſes of the temporal bones, proceſſes of the *vertebræ*, *trochanters* of the thigh, &c. However, as I deſign to inſiſt chiefly on the deſcription of the adult ſkeleton, in which the union of theſe parts is ſo intimate, that ſcarce any veſtige remains of their former ſeparation, I ſhall retain the common appellation of *apophyſe*, or proceſs, to all ſuch protuberances; but ſhall remark the principal ones that have no juſt title to this name, when they occur in the deſcription of particular bones.

On the ſurfaces of a great many of the bones there are cavities, or depreſſions: If theſe are deep, with large brims, authors name them *cotylæ**—If they are ſuperficial, they obtain the deſignation of *glenæ*, or *glenoid*. Theſe general *claſſes* are again divided into ſeveral *ſpecies*:—Of which *pits* are ſmall roundiſh channels ſunk perpendicularly into the bone.—*Furrows* are long narrow canals, formed in the ſurface;—*nitches* or *notches*, ſmall breaches in the bone;—*ſinuoſities*, broad, but ſuperficial depreſſions without brims;—*foſſæ*, large deep cavities, which are not equally ſurrounded by high brims;—*ſinuſes*, large cavities within the ſubſtance of the bones, with ſmall apertures;—*foramina*, or holes, canals that pierce quite through the ſubſtance of the bones.—When this

* Κοτυλίδες, ὀξυβάφοι, Acetabula, pixides, buccellæ.

this laſt ſort of cavity is extended any long way within a bone, the middle part retains the name of *canal*, and its ends are called holes.

The cavities allow the heads of bones to play in them; they lodge and defend other parts; they afford ſafe paſſage to veſſels, muſcles, &c. To mention more would engage us too much in the hiſtory of particular bones, which more properly belongs to the demonſtration of the *ſkeleton*, where we ſhall have occaſion to obſerve theſe ſeveral ſpecies of cavities.

To far the greater number of bones, whoſe ends are not joined to other bones by an immoveable articulation, there are ſmaller ones annexed, which afterwards become ſcarce diſtinguiſhable from the ſubſtance of the bone itſelf. Theſe are called *epiphyſes*, or *appendices**. Some bones have one, others have two, three, or four of theſe *appendices* annexed by the means of cartilages, which are of a conſiderable thickneſs in children, but by age become thinner; the oſſification proceeding from the end of the bone on one ſide, and from the *epiphyſes* on the other, till at laſt, in adults, the place of their conjunction can ſcarcely be ſeen on the external ſurface; and it is only ſometimes that we can then ſee any mark of diſtinction in the *cancelli* (*a*).

Several proceſſes (*e. g. trochanters* of the thigh, *ſpine* of the *ſcapula*, &c.) have *epiphyſes*; and proceſſes frequently riſe out from *epiphyſes*;

* Applantatio, additamentum, adnaſcentia, adnexum, perone.

(*a*) Winſlow, Expoſition anatomique de corps humain, traite des os ſecs. § 116.

epiphyſes; for example, at the lower end of the *femur*, *ulna*, *tibia*, &c. *(a)*.

The *epiphyſes* are united chiefly to ſuch bones as are deſtined for frequent and violent motion; and for this purpoſe they are wiſely framed of a larger diameter than the bone they belong to; for by this means, the ſurface of contact between the two bones of any articulation being increaſed, their conjunction becomes firmer, and the muſcles inſerted into them act with greater force, by reaſon of their axes being further removed from the center of motion. Theſe advantages might indeed have been obtained by the expanſion of the end of the bone itſelf, to a thickneſs equal to that of the *epiphyſes*; but then the conſtant ſeparation of new plates to form ſo wide a cellular ſtructure, muſt have left the ſolid ſides of the bones ſo thin, as to yield eaſily, either to the action of the muſcles fixed to them, and paſſing over them, to the weight ſeveral of them are obliged to ſupport, or to the application of any other external force.

Several anatomiſts *(b)* thought that the *epiphyſes* ſerve other purpoſes: ſuch as, ſecuring the ligaments of the articulations which riſe out from between the bones and them; for, as ſoon as theſe parts are intimately joined, the ligaments inſinuated betwixt them muſt have a much ſtronger connection than they could have to the ſmooth ſurface of the bones. Such an interception of the ligament betweeen the body of

(a) Veſſel. De human. corp. fabrica, lib. 1. cap. 3.
(b) Collumb, de re anatomica, lib. 1. cap. 2.——Fallop. Expoſ. de offibus, cap. 11.

of the bones and its *epiphyſe* is not to be ſeen; but as, at this place, the bone remains longer ſoft than any where elſe, and the adheſion of the *perioſteum*, and of ligaments to bones, is always ſtronger in proportion to the bones being neareſt to the conſiſtence of thoſe parts, which is, being ſofteſt, the opinion of theſe writers concerning the ſtronger connection of the ligaments, where the bones and *epiphyſes* join, is not without ſome foundation.

Poſſibly too, by the fibres of *epiphyſes* not extending themſelves ſo longitudinally as thoſe of the bones, there may be leſs chance of the former running into each other, than of the latter.

The ſoftneſs of the ends of bones may be of ſome advantage in the womb, and at birth, after which the oſſification begins at different points to form *epiphyſes*, before the oſſification can extend from the middle to the ends of the bones *(a)*.

However ſolid and compact adult bones are, yet they were once cartilages, membranes, nay, a mere gelly. This needs no further proof, than repeated obſervations of *embryos* when diſſected: And how much more tender muſt the bones be before that time, when neither knife nor eye is capable to diſcover the leaſt rudiments of them? By degrees they become more ſolid, then aſſume the nature of griſtles, and at laſt oſſify; the coheſion of their plates and fibres always increaſing in proportion to their increaſed ſolidities; as is evident from the time neceſſary to unravel the texture of

(*a*) Haller de ſtudio medic. p. 267.

of the bones of people of different ages, or of denſe and of ſpongy bones, or of the different parts of the ſame bone, and from the more tedious exfoliations of the bones of adults than of children.

After any part of a bone is fully oſſified, its fibres are extended little more in length, at that part, though they increaſe there in thickneſs, and though their ſofter parts continue to become longer *(a)*.

As the ſolidity of bones increaſes, their *perioſteum* more eaſily ſeparates from them. When bones are membranous, the *perioſteum* and they cannot be diſtinguiſhed; they appear to be the ſame ſubſtance. When they are cartilages, their membrane adheres ſo firmly to them, that it is difficult to ſeparate it from them. Where the rigid bony fibres are, the *perioſteum* is eaſily taken off.—Is the ſimilarity of ſtructure and conſequent greater attraction of the membrane and ſubſtance it incloſes, while they are both flexible the cauſe of their greater adheſion? or is it owing to the veſſels that go from the one to the other being then larger? or do both theſe cauſes combine to produce this effect? Or is the membrane or cartilage, which becomes bone afterwards, to be conſidered as the ſame ſubſtance with the *perioſteum (b)?* and muſt all theſe plates of bones be therefore ſaid to be layers of the *perioſteum* hardened *(c)*?

The

(a) Hales's Vegetable ſtatics, p. 293.—Du Hamel Memoires de l'acad. des ſciences, 1742.

(b) Memoires de l'acad. des ſciences, 1744.

(c) Memoires de l'acad. des ſciences, 1743.

The oſſification of bones depends principally on their veſſels being ſo diſpoſed, and of ſuch diameters, as to ſeparate a liquor, which may eaſily turn into a bony ſubſtance, when it is deprived of its thinner parts; as ſeems plain from the obſervation of the callous matter ſeparated after fractures and ulcers, where part of the bone is taken out: For in theſe caſes, the veſſels extending themſelves, and the liquors added to them, are gradually formed into granulated fleſh; which fills up all the ſpace where the bone is taken from, then hardens, till it becomes as firm as any other part of the bone. This happens frequently, even when the ends of the diſeaſed bone are at a conſiderable diſtance from each other *(a)*.

The induration of bones is alſo greatly aſſiſted by their being expoſed, more than any other parts, to the ſtrong preſſure of the great weights they ſupport, to the violent contraction of the muſcles fixed to them, and to the force of the parts they contain, which endeavour to make way for their own further growth. By all this preſſing force, the ſolid fibres and veſſels of bones are thruſt cloſer; and ſuch particles of the fluids conveyed into theſe veſſels as are fit to be united to the fibres, are ſooner and more firmly incorporated with them, while the remaining fluids are forcibly driven out by the veins, to be mixed with the maſs of blood. In conſequence of this, the veſſels gradually

(a) Hildan de vuln. graviſ.—Med. eſſays, vol. 1. art. 23.—Job a Meckren obſ 69.—Mem. de l'acad. des ſciences, 1742.—See collection of ſuch caſes in Bochmer de oſſium callo.

dually diminiſh as the bones harden. From which again we can underſtand one reaſon, why the bones of young animals ſooner reunite after a fracture than thoſe of old, and why cattle that are put too ſoon to hard labour, ſeldom are of ſuch large ſize as others of the ſame brood who are longer kept from labour.

That the oſſifying of bones greatly depends on preſſure, ſeems to be evinced from the frequent examples we meet with of other parts turning bony, when long expoſed to the preſſing force of the ſurrounding parts, or when they are ſubjected to the like circumſtances by their own frequent and violent contraction. Witneſs, the bones found frequently near the baſe of the heart in ſome old men (*a*), and in ſeveral other creatures. Nay, the muſcular ſubſtance of the heart has been oſſified in ſuch (*b*), and the arteries of old men often become bony.——The cartilages of the *larnyx* are generally oſſified in adults.—In beaſts of burden, the cartilages between the *vertebræ* of the back very often change into compleat bones; and, being intimately united with the *vertebræ*, the whole appears one continued bone:—Nor is the *perioſteum* exempted from ſuch an induration (*c*).

To confirm this argument ſtill farther, we may obſerve, that bones begin their oſſification

(*a*) Riolan. Comment. de oſſib. cap. 32.—Bartholin. Hiſt. medic. cent. 1. hiſt. 50.——Ibid. cent. 2. hiſt. 45.

(*b*) Cheſelden, Anatomy, book 1. introd.——Garengeot. Hiſt. de l'acad. des ſciences, 1726.

(*c*) Peyer. Ephemerid. German. decur. 2. ann. 7. obſerv. 205.

cation at the places where they are moſt expoſed to theſe cauſes, *viz.* in the cylindrical bones from a middle ring, and in the broad ones, at or near their center, from one or more diſtinct points. The reaſon of which is, That theſe parts are contiguous to the bellies of the muſcles annexed to the bones, where the ſwelling of theſe moving powers is greateſt. What the effects of this may be, let any judge, who view ſome of the bones, as the *ſcapula*, and *oſſa ilium*, which are covered with muſcles on each ſide; how compact and thin they are in adults, where the bellies of the muſcles were lodged; whereas in children they are thicker. But this being the middle part of theſe bones, where the greateſt number of fibres is, this particular place would have been much thicker in adults, had not this forcible cauſe been applied, which has not had ſuch effects in children, whoſe muſcles have not been much exerciſed.—Beſides, if we allow that all the parts of a bone are equally increaſed by the conſtant ſupply of new particles, each fibre, and every particle of a fibre, endeavours to make way for its own growth, by puſhing the one next to it; and conſequently by far the greateſt preſſure is on the middle to make the particles firm, and therefore to begin their oſſification there. Laſtly, the pulſation of the medullary arteries, which enter the bones near to this middle part, may, as authors have alledged, contribute perhaps ſomewhat to this induration. From the effects of preſſure only it is, that we can account for the bones of old people having their ſides much thinner, yet more denſe

denſe and ſolid, while the cavities are much larger than in thoſe of young people; and for the prints of muſcles, veſſels, &c. being ſo much more ſtrongly marked on the ſurfaces of the former than the latter, if they belong to people of near the ſame condition in life.—Preſſure muſt likewiſe be the cauſe, which, in people of equal ages, makes theſe prints ſtronger in the bones of thoſe who had much labour and exerciſe, than they are in people who have led an indolent unactive life.

Perhaps both the cauſes of oſſification above-mentioned, may be aſſiſted by the nature of the climate people live in, and the food they uſe. Whence, in hot countries, the inhabitants ſooner come to their height of ſtature than in the northerly cold regions: And thence ſeems to have ariſen the common practice among the ladies, of making puppies drink brandy or ſpirit of wine, and of bathing them in theſe liquors, to prevent their growing big. Nay, it has been obſerved, that much uſe of ſuch ſpirits has occaſioned parts, naturally ſoft, to petrify in ſome, and to oſſify in other people of no great age (*a*).

From the foregoing account of the ſtructure of bones, and of their oſſification, we may underſtand the reaſons of the following phænomena.

How the natural colour of bones may be changed by ſome ſorts of food (*b*).

Why

(*a*) Littre, Hiſtoire de l'acad. des ſciences, 1706—Geoffroy, Memoires de l'acad. des ſciences, 1706.

(*b*) Philoſoph. Tranſact. 442. art. 8. numb. 443. art. 2. numb. 457. art. 4. Mem. de l'acad. des ſciences, 1739, 1741.

Why the bones of ſome people are ſo long in hardening, and in others never compleatly indurate.

Why, in ſuch whoſe oſſification is ſlow, the bones are generally thicker in proportion to their lengths, eſpecially at their ends; as in the *rickets*.

How hard firm bones have become ſoft and pliable by diſeaſes (*a*).

Why in ſome diſeaſes, *epiphyſes* ſeparate from bones (*b*), and the ends of fractured bones come aſunder many years after their fractures appeared to be cured (*c*).

How bones may waſte and diminiſh (*d*).

How bones may become ſolid all through, without any appearance of *cancelli* (*e*).

How *nodes*, *tophi*, and *exoſtoſes*, happen after the eroſion of the external plates of bones in the *lues venerea*, *ſcurvy*, *rheumatiſm*, and *gout*.

How bones exfoliate by the riſing of granulated fleſh from their ſurface.

How and from what *callus* is formed after a fracture (*f*).

Why

(*a*) Hiſtoire de l'acad. des ſciences, 1700.—Mem. 1722—Gagliardi, Anatom. offium, cap. 2. obſerv. 3.—Ephem. Germ. decur. 1. ann. 1. obſ. 37. et ſchol. decur. 2. ann. 7. obſ. 212, 235. decur. 3. ann. 2. obſ. 3.——Philoſ. Tranſ. No. 470. § 3. Ibid. vol. 48. § 4. and 44.

(*b*) Memoires de l'acad. des ſciences, 1699.—Diemerbrook, Anat. lib. 9. cap. 19.—Cowper's Anat. explic. tab. 96. fig. 1.

(*c*) Anſon's Voyage.

(*d*) Cheſelden, Anat. book 1. introd.—Hiſt. de l'acad. des ſciences, 1700.

(*e*) Ruyſch. Theſaur, 2. arc. 5. theſ. 3. loc. 1. numb. 5. theſ. 9. numb. 2. not. 3.—Bochmer de cailo offium.

(*f*) Memoires de l'acad. des ſciences. 1741.—Dehtleef de offium callo.

Why *callus* appears to be rather the continued ſubſtance of the *perioſteum* than of the bone, while it remains ſoft and flexible; but ſeems continued with the bone after it oſſifies (*a*).

Why *callus* is ſenſible, while it is ſoft, but becomes inſenſible when it hardens.

What occaſions ſometimes ſuch difficulty in curing fractured bones; or why they never reunite, though they are reduced, and all proper means towards a cure are uſed (*b*).—Are the bones of women with child more tedious in reuniting than thoſe of other people (*c*)?

Why *calluſes*, after fractures, are ſometimes very thick and protuberant.

What difference there ought to be in the application of bandages to fractures of the bones of old and of young patients.

How bones, remaining long unreduced after a luxation, may have their form ſo changed as to make their reduction very difficult, if not impoſſible (*d*).

Whoever is deſirous to know, in what time and order each bone and its ſeveral parts begin to aſſume a bony nature, let him conſult *Kerchingius*

(*a*) Mem. de l'acad. 1741.

(*b*) Meckren Obſerv. medico-chirurg. obſ. 71.—Ruyſch. Adverſ. dec. 2. § 2. obſerv. anat. chir. obſ. 4.—Van Swieten in Boerhave Aphor. § 354.

(*c*) Hildan. centur. 5. obſ. 87. et cent. 6. obſ. 68.——Philoſ. Tranſact. No. 494. § 21.

(*d*) Saltzman. Obſ. decur. obſ. 6.—Memoires de l'acad. de chirurgic. tom. 2. p. 155.——Bochmer Inſtit. oſteolog. § 596.

Kerchingius (*a*), who gives us the delineations of abortions from three days after conception, and traces the oſſification of the bones from three weeks, and a month, till the time of the birth: To whom ſhould be added *Coiterus* (*b*) and *Eyſſonius* (*c*). An account of this ſubject might alſo be collected out of Ruyſch's works, where ſome of the miſtakes committed by the former authors are corrected: and ſeveral more particulars, to make the hiſtory of the *oſteogenea* more accurate, have ſince been added by *Neſbit* (*d*) and *Albinus* (*e*).

I muſt refer to the authors now quoted for the more curious part of the human oſteogeny; not having preparations enough to give ſuch a full hiſtory of it as is done by them. But I ſhall endeavour to explain the more uſeful and neceſſary part of the oſteogeny, by ſubjoining to the deſcription of each bone of an adult, its condition in ripe children; that is, in ſuch as are born at the ordinary time; and ſhall point out what parts of each are afterwards joined in form of *epiphyſes*. This, with the following general rules, ſeem to me ſufficient for underſtanding what of this ſubject is neceſſary in the practice of phyſic and ſurgery.

1. Wherever I mention any parts being cartilaginous, or their being ſtill ſeparable from the other parts of the bone to which they belong,

(*a*) Anthropograph. ichnograph. et oſteogenea foetuum
(*b*) De oſſibus foetus abortivi.
(*c*) De oſſibus infant. cognoſcend. et curand.
(*d*) Human Oſteogeny explained.
(*e*) Icones oſſium foetûs humani; accedit oſteogeneae brevis hiſtoria.

long, I would be underſtood to hint, that, about ſeven or eight years of age, ſuch parts are oſſified and united to their proper bones, unleſs when it is ſaid, that they are afterwards formed into *epiphyſes*.

2. Such as become *epiphyſes*, are generally oſſified at ſeven or eight years of age; but, being for the moſt part moiſtened by *ſynovia*, their external ſurface is ſtill ſomewhat cartilaginous, and they are not yet united to their bones.

3. At eighteen or twenty years of age the *epiphyſes* are entirely oſſified, and have blended their fibres ſo with the body of the bone, as to make them inſeparable without violence.

The knowledge of this part of the *oſteogeny* I think neceſſary, to prevent dangerous miſtakes in the cure of ſeveral diſeaſes. As for example: Without this knowledge, the ſeparation of an *epiphyſe* might be miſtaken for a fracture or luxation.—The interſtice of two parts of a bone not yet joined, might be judged to be a fiſſure.—A *diaſtaſis*, or ſeparation of ſuch disjoined pieces of a bone, might be thought a fracture.—The protruſion of one piece, or its overlopping any other, could be miſtaken for an excreſcence or *exoſtoſis*.—Such errors about the nature of a diſeaſe would give one very different indications of cure, from what he would have, if he really underſtood his patient's caſe. And very often the knowledge of the different inequalities on the ſurfaces of bones, muſt direct us in the execution of what is proper to be done to cure ſeveral of their diſeaſes.

Having

Having thus conſidered the bones when ſingle, we ought next to ſhew the different manner of their conjunctions *. To expreſs theſe, anatomiſts have contrived a great number of technical terms; about the meaning, propriety, and claſſing of which, there has unluckily been variety of opinions. Some of theſe terms it is neceſſary to retain, ſince they ſerve to expreſs the various circumſtances of the articulations, and to underſtand the writers on this ſubject.

The ARTICULATIONS are moſt commonly divided into three claſſes, viz. *ſymphyſis*, *ſynarthroſis* and *diarthroſis*.

Symphyſis, which properly ſignifies the concretion or growing together of parts, when uſed to expreſs the articulations of bones, does not ſeem to comprehend, under the meaning generally given to it, any thing relating to the form or motion of the conjoined bones; but by it moſt authors only denote the bones to be connected by ſome other ſubſtance; and as there are different ſubſtances which ſerve this purpoſe, therefore they divide it into the three following ſpecies:

1. *Synchondroſis* †, when a cartilage is the connecting ſubſtance: Thus the ribs are joined to the *ſternum*; thus the bodies of the *vertebræ* are connected to each other; as are likewiſe the *oſſa pubis*.

2. *Syn-*

* Σύνταξις, σύνθεσις, συμβολὴ, ὁμιλια, compoſitio, connexio, articulatio, conjunctio, nodus, commiſſura, ſtructura, compages.

† Amphiarthroſis.

2. *Synneuroſis*, or *ſyndeſmoſis*, when ligaments are the connecting bodies, as they are in all the moveable articulations.

3. *Syſſarcoſis*, when muſcles are ſtretched from one bone to another, as they muſt be where there are moveable joints.

The *ſecond* claſs of articulations, the *ſynarthroſis*, which is ſaid to be the general term by which the immoveable conjunction of bones is expreſſed, is divided into three kinds.

1. The *future* * is that articulation where two bones are mutually indented into each other, or as if they were ſowed together, and is formed by the fibres of two bones meeting while they are yet flexible and yielding, and have not come to their full extent of growth; ſo that they mutually force into the interſtices of each other, till, meeting with ſuch reſiſtance as they are not able to overcome, they are ſtopped from ſprouting out farther, or are reflected; and therefore theſe indentations are very different both in figure and magnitude: Thus the bones of the head are joined; thus *epiphyſes* are joined to the bones, before their full connection and union with them.

Under this title of *future*, the *harmonia* of the antients may be comprehended; ſcarce any unmoved bones being joined by plain ſurfaces *(a)*.

2. *Gomphoſis* † is the fixing one bone into another, as a nail is fixed in a board: Thus the teeth are ſecured in their ſockets.

* Ῥαφη.
(a) Veſal. Obſerv. Fallop. Examen.
† Conclavatio.

3. *Shindyleſis* or *ploughing (a)* when a thin *lamella* of one bone is received into a long narrow furrow of another: Thus the *proceſſus azygos* of the *ſphenoid*, and the naſal proceſs of the *ethmoid* bone, are received by the *vomer*.

The *third* claſs, or *diarthroſis* *, is the articulation where the bones are ſo looſely connected as to allow large motion. This is ſubdivided into three kinds.

The firſt is *enarthroſis*, or the ball and ſocket, when a large head is received into a deep cavity; as the head of the *os femoris* is into the *acetabulum coxendicis*.

The ſecond is *arthrodia*, when a round head is received into a ſuperficial cavity; as in the articulation of the arm bone and *ſcapula*. Theſe two ſpecies of *diarthroſis* allow motion to all ſides.

The third is *ginglimus* †, which properly ſignifies the hinge of a door or window; in it the parts of the bones mutually receive and are received, and allow of motion two ways: Workmen call it *charnal*.

The *ginglimus* is generally divided into three kinds, to which ſome *(b)* give the name of *contiguous* ‡, *diſtant* ‖, and *compound* §.

The firſt kind of *ginglimus* is, when a bone has ſeveral protuberances and cavities, which anſwer to as many cavities and proceſſes of the other

(a) Keil, Anat. chap. 5. § 3.

* Απαρθρώσις, dearticulatio, abarticulatio.

† Articulatio mutua.

(b) Baker, Curſ. oſteolog: demonſtr. 1.

‡ Proximus.

‖ Longus.

§ Compoſitus.

other bone, with which it is articulated; as in the conjunction of the *femur* with the *tibia*.

The second species is, when a bone receives another at one end, and is received by the same bone at the other end; as in the *radius* and *ulna*.

The last sort is, when a bone receives another, and is received by a third; as in the oblique processes of the *vertebræ*.

When I first mentioned the articulations of bones, I said there were different opinions concerning the use of their technical names, *e. g.* It has been said, that *symphysis* should be the name for the immoveable articulations, and *synarthrosis* should be understood to be the conjunction of bones by some connecting *medium*.——Those who have taken *symphysis* in the sense I did, of its expressing the conjunction of bones with a connecting substance, have disagreed in their definition of it; some inserting, and others leaving out, its allowing motion.—Where they have agreed in their definition, they have not been of the same mind concerning the species of it. For several think the *Sysarcosis* and *syndesmosis* applicable to so many joints which are universally allowed to be classed under the *diarthrosis*, that it must create confusion to name them by any species of the *symphysis*.——Few keep to such a general definition of the *synchondrosis* as I have done; and, whether they determine it to allow no motion, or an obscure or a manifest one, bring themselves into difficulties, because there are examples of all these three kinds.——Some again, by too nicely distinguishing obscure and

manifeſt motions of bones, have blended the *ſynarthroſis* and *diarthroſis* and from thence have branched out the different compound ſpecies of articulations that may be formed of them ſo far, that they could find no examples in the body to illuſtrate them by.—It would be tedious to enumerate more of the jarring opinions, and it would be far more ſo to give a detail of the arguments uſed by the diſputants. It is ſufficient for my purpoſe, that it is underſtood in what ſenſe I take theſe technical terms; which I do in the following manner:

When I mention the *ſymphyſis* or *ſynarthroſis*, or any ſpecies of them, I ſhall always underſtand them according to the explication already given of them. But though the preceding account of the *diarthroſis*, or articulation of moveable bones, has been almoſt univerſally received; yet, ſeeing it does not comprehend all the moveable articulations of the body, and one of its ſpecies does not anſwer to any notion we can have of the conjunction of two bones, I muſt beg leave to change the definitions and kinds of theſe joints.

I would call *diarthroſis* that conjunction of bones, whereby they are fitted for motion, being each covered with a ſmooth cartilage, connected by one or more common ligaments, and lubricated with liquor at the conjoined parts. In which definition, I have no regard to the quantity of motion which they really do perform; the motion being often confined or enlarged by ſome other cauſe not immediately depending on the frame of the two ſurfaces of the

the bones forming the particular joint which then is conſidered.

The firſt ſpecies of the *diarthroſis*, *viz.* the *enarthroſis* or ball and ſocket, I would define more generally than above, That articulation where a round head of one bone is received into a cavity of another, and conſequently, without ſome foreign impediment, is capable of motion to all ſides. Examples of this kind are to be ſeen in the articulation of the thigh-bone and *oſſa innominata*; Arm-bone and *ſcapula*; *aſtragalus* and *os naviculare*; *magnum* of the wriſt, with the *ſcaphoides* and *lunare*; firſt bone of the thumb with the ſecond, *&c.*

The ſecond ſort, or the *arthrodia*, differing from the *enarthroſis*, in the preceding account, only in the cavity's being more ſuperficial, which makes no eſſential difference, eſpecially that, in the recent ſubject, cartilages or ligaments ſupply the deficiency of bone, ought, in my opinion, to be called with *Veſalius (a)* that articulation of two bones adapted for motion, where it is not at firſt ſight obvious which of the two has the head or cavity, or where they are joined by plain ſurfaces, or nearly ſo; ſuch is the conjunction of the *clavicle* with the *ſcapula*; *oſſa cuneiformia* with the *os naviculare*; *metatarſal* bones with the *oſſa cuneiformia*, *&c.* From the nature of this ſort of joint, it is plain, that very great motion cannot be allowed, without the bones going farther out of their natural ſituation, than is convenient or ſafe.

(*a*) De corp. human. fabrica. lib. 1. cap. 4.

Ginglimus, I would reckon that articulation by the form of which the motion of the joined bones muſt be chiefly confined to two directions, which hinges of doors are.

The firſt ſpecies of this is the *trochoides*, when one bone turns on another, as a wheel does on its axis: Thus the firſt *vertebra* of the neck moves on the tooth-like proceſs of the ſecond. This is the moſt proper kind of *ginglimus*.

The ſecond ſpecies ſhould be eſteemed that articulation where ſeveral prominent and hollow ſurfaces of two bones move on each other, within the ſame common ligament; as in the knee, elbow, *&c.*

The third ſort of *ginglimus* is, when two bones are articulated to each other at different parts, with a diſtinct *apparatus* of the motory machines at each; ſuch is the articulation of the *os occipitis* with the firſt *vertebra* of the neck; of any two contiguous *vetrebræ*, by their oblique proceſſes; of the ribs with the bodies and tranſverſe proceſſes of the *vertebræ*; of the *radius* with the *ulna*, *tibia* with the *fibula*, *aſtragulus* with the *calcaneum*, *&c.*

I would entirely throw out what is commonly called the third kind of *ginglimus*: For, in examining the conjunction of a bone with two others, as in the common example of a *vertebra* joined with the one above and below, the connection of the middle one with each of the other two ought to be conſidered ſeparately; otherwiſe we might with the ſame propriety eſteem the articulations that the long bones, the *femur*, *tibia*, *humerus* *&c.* have at their different

ferent ends, as one articulation; which is abſurd.

If the moveable bones are not connected and kept firm by ſome ſtrong ſubſtance, they would be luxated at every motion of the joints; and if their hard rough unequal ſurfaces were to play on each other, their motion would not only be difficult, but the loſs of ſubſtance from attrition would be great. Therefore *ligaments* are made to obviate the firſt, and *cartilages* to prevent the other inconveniency. But becauſe ligaments and *cartilages* turn rigid, inflexible, and rough, unleſs they are kept moiſt, a ſufficient quantity of liquors is ſupplied for their lubrication, and to preſerve them in a flexible ſtate. Seeing then theſe parts are ſo neceſſary to the articulations, I ſhall next conſider their ſtructure, ſituation, and uſes, ſo far as they are ſubſervient to the bones, and their motions.

LIGAMENTS * are white flexible bodies, thicker and firmer than membranes, and not ſo hard or firm as cartilages, without any remarkable cavity in their ſubſtance, difficultly ſtretched, and with little elaſticity; ſerving to connect one part to another, or to prevent the parts to which they are fixed from being removed out of that ſituation which is uſeful and ſafe.

After maceration in water, the ligaments can eaſily be divided; and each ligamentous layer appears compoſed of fibres, the largeſt of which are diſpoſed in a longitudinal direction.

* Σύνδεσμοι, νεῦροι, copulæ, vincula.

The *arteries* of ligaments are very conſpicuous after a tolerable injection, and the larger trunks of their veins are ſometimes to be ſeen full of blood.

Such ligaments as form the ſides of cavities, have numerous orifices of their arteries opening upon their internal ſurface, which keep it always moiſt: If we rub off that moiſture, and then preſs the ligament, we can ſee the liquor ouſing out from ſmall pores; and we can force thin liquors injected by the arteries into the cavities formed by ligaments.

Theſe exhalent arteries muſt have correſponding abſorbent *veins*, otherwiſe the cavities would ſoon be too full of liquor.

Ligaments then muſt be ſubject to the diſeaſes common to other parts, where there is a circulation of fluids, allowance always being made for the ſize of veſſels, nature of the fluids, and firmneſs of the texture of each part.

Authors generally ſay, that ligaments are inſenſible: and conſequently it may be inferred, that they have no nerves beſtowed on them. But the violent racking pain felt on the leaſt motion of a joint labouring under a *rheumatiſm*, the ſeat of which diſeaſe ſeems often to be in the ligaments, and the inſufferable torture occaſioned by inciſions of ligaments, and by a collection of acrid matter in a joint, or by *tophi* in the gout, would perſuade us, that they are abundantly ſupplied with nerves.

The ligaments which connect the moveable bones commonly riſe from the conjunction of the *epiphyſes* of the one bone, and

are

are inſerted into the ſame place of the other; or where *epiphyſes* are not, they come out from the *cervix*, and beyond the *ſupercilia* of the articulated bones; and after ſuch a manner, in both caſes, as to include the articulation in a purſe or bag, with this difference, depending on their different motions, that where the motion is only to be in two directions, the ligaments are ſtrongeſt on thoſe ſides towards which the bones are not moved; and when a great variety of motions is deſigned to be allowed, the ligaments are weaker than in the former ſort of articulations, and are nearly of the ſame ſtrength all round.

Part of the capſular ligaments is compoſed of the *perioſteum*, continued from one bone to another, as was obſerved *p.* 2. and their internal layer is continued on the parts of the bone or cartilage which the ligament includes *(a)*.

Beſides theſe common capſular ligaments of the joints, there are particular ones in ſeveral places, either for the firmer connection of the articulated bones, or for reſtraining and confining the motion to ſome one ſide; ſuch are the croſs and *lateral* ligaments of the knee, the *round* one of the thigh, &c.

From this account of the ligaments, we may conclude, that, *cæteris paribus*, in whatever articulation the ligaments are few, long, and weak, the motion is more free and quick; but luxations happen frequently: And, on the contrary, where the ligaments are numerous, ſhort, and ſtrong, the motion is more confined, but ſuch a joint is leſs expoſed to luxations

(a) Neſbit, Oſteogen.—Philoſ. tranſact. No. 470. § 6.

(a).——Whence we may judge how neceſſary it is to attend to the different ligaments, and the changes which have been made on them by a luxation, when it is to be reduced.

Ligaments alſo ſupply the place of bones in ſeveral caſes to advantage: Thus the parts in the *pelvis* are more ſafely ſupported below by ligaments, than they could have been by bone.——The ligaments placed in the great holes of the *oſſa innominata*, and between the bones of the fore-arm and leg, afford convenient origin to muſcles.—Immoveable bones are firmly connected by them; of which the conjunction of the *os ſacrum* and *innominatum* is an example.———They afford a ſocket for moveable bones to play in, as we ſee part of the *aſtragalus* does on the ligament ſtretched from the heel-bone to the *ſcaphoid*.

Numerous inconveniencies may ariſe from too long or ſhort, ſtrong or weak, lax or rigid ligaments.

CARTILAGES * are ſolid, ſmooth, white, elaſtic ſubſtances, between the hardneſs of bones and ligaments, and covered with a membrane, named *perichondrium*, which is of the ſame ſtructure and uſe to them as the *perioſteum* is to the bones.

Cartilages are compoſed of plates, which are formed of fibres, diſpoſed much in the ſame way as thoſe of bones are; as might be reaſonably concluded from obſerving bones in a cartilaginous ſtate before they oſſify, and from ſeeing, on the other hand, ſo many cartilages become bony. This may be ſtill further confirmed,

(a) Fabric. ad Aquapend. de articul. part. utilit. pars 3.

* Χονδροὶ.

firmed, by the *exfoliation* which cartilages are ſubject to, as well as bones.

The *perichondrium* of ſeveral cartilages, for example, thoſe of the ribs and *larynx*, has arteries which can be equally well injected with thoſe of the *perioſteum*; but the veſſels of that membrane in other parts, *e. g.* the articular cartilages, are ſmaller, and in none of them does injection enter deep into the ſubſtance of the cartilages; nay, madder, mixed with the food of animals, does not change the colour of cartilages, as it does that of bones *(a)*.

The granulated fleſh which riſes from the ends of metacarpal or metatarſal bones, when the cartilage exfoliates, after a finger or toe has been taken off at the firſt joint, is very ſenſible, from which the exiſtence of nerves in cartilages may be inferred.

While cartilages are in a natural ſtate, it is to be remarked, *firſt*, That they have no cavity in their middle for marrow. *Secondly*, That their outer ſurface is ſofteſt, which renders them more flexible. *Thirdly*, That they do not appear to change their texture near ſo much by acids as bones do. And *laſtly*, That as the ſpecific gravity of cartilages is near a third leſs than that of bones; ſo the coheſion of their ſeveral plates is not ſo ſtrong as in bones; whence cartilages laid bare in wounds or ulcers, are not only more liable to corrupt, but exfoliate much ſooner than bones do.

Cartilages

(a) Philoſ. Tranſact. No. 442. art. 8. No. 443. art. 2. No. 457. art. 4. Mem. de l'acad. des ſciences, 1739. et 1742 —Dehleef de oſſium callo.

Cartilages ſeem to be principally kept from oſſifying, either by being ſubjected to alternate motions of flexion and extenſion, the effects of which are very different from any kind of ſimple preſſure, or by being conſtantly moiſtened (*a*): Thus, the cartilages on the articulated ends of the great bones of the limbs, and the moveable ones placed between the moving bones in ſome articulations, which are obliged to ſuffer many and different flexions, and are plentifully moiſtened, ſcarce ever change into bone; while thoſe of the ribs and larynx are often oſſified.——The middle angular part of the cartilages of the ribs, which is conſtantly in an alternate ſtate of flexion and extenſion, by being moved in reſpiration, is always the laſt of becoming bony.——In the *larynx*, the *epiglottis*, which is oftener bended and more moiſtened than the other four cartilages, ſeldom is oſſified, while the others as ſeldom eſcape it in adults.

The cartilages ſubſervient to bones, are ſometimes found on the ends of bones which are joined to no other; but are never wanting on the ends, and in the cavities of ſuch bones as are deſigned for motion (*b*). Cartilages alſo are interpoſed between ſuch other cartilages as cover the heads and cavities of articulated bones; nay, they are alſo placed between immoveable bones.

The uſes of cartilages, ſo far as they regard bones, are, to allow, by their ſmoothneſs, ſuch bones as are deſigned for motion, to ſlide eaſily

(*a*) Havers Oſteolog. nov.
(*b*) Celſ. de re medic. lib. 8. cap. 1.

ſily without detrition, while, by their flexibility, they accommodate themſelves to the ſeveral figures neceſſary in different motions, and, by their elaſticity, they recover their natural poſition and ſhape as ſoon as the preſſure is removed.—This ſpringy force may alſo aſſiſt the motion of the joint to be more expeditious, and may render ſhocks in running, jumping, &c. leſs.—To theſe cartilages we chiefly owe the ſecurity of the moveable articulations: For without them the bony fibres would ſprout out, and intimately coaleſce with the adjoining bone; whence a true *anchyloſis* muſt neceſſarily follow; which never fails to happen when the cartilages are eroded by acrid matter, or oſſified from want of motion or defect of liquor, as we ſee often happens after wounds of the joints, *paidarthrocace*, *ſcrophula*, and *ſpina ventoſa*, or from old age, and long immobility of joints (*a*).—Hence we may know what the annihilation is which is ſaid to be made of the head of a bone, and of the cavity for lodging it, after an unreduced fracture (*b*). The moveable cartilages interpoſed in joints ſerve to make the motions both freer and more ſafe than they would otherwiſe be.——Thoſe placed on the ends of bones that are not articulated, as on the *ſpine* of the *os illium*, baſe of the *ſcapula*, &c. ſerve

(*a*) Columb. de re anat. lib. 15.—Deſlandes Hiſt. de l'acad. des ſciences 1716 ——Phil. tranſact. No. 215.—Ibid. No. 461. § 16.

(*b*) Hildan. de ichor. et melicer. acri Celſi. cap. 5.—— Ruyſch. Theſ. 8. No. 103. Saltzman in act. Petropolit. Tom 3. p. 275.

ſerve to prevent the bony fibres from growing out too far.——Cartilages ſometimes ſerve as ligaments, either to faſten together bones that are immoveably joined, ſuch are the cartilages between the *os ſacrum* and *oſſa illium*, the *oſſa pubis*, &c. or to connect bones that enjoy manifeſt motion, as thoſe do which are placed between the bodies of the true vertebræ, &c.—Cartilages very often do the office of bones to greater advantage than theſe laſt could, as in the cartilages of the ribs, thoſe which ſupply brims to cavities, &c.

Too great thickneſs or thinneſs, length or ſhortneſs, hardneſs or ſuppleneſs of cartilages, may therefore cauſe great diſorders in the body.

The liquor, which principally ſerves to moiſten the ligament and cartilages of the articulations, is ſupplied by glands, which are commonly ſituated in the joint, after ſuch a manner as to be gently preſſed, but not deſtroyed by its motion. By this means, when there is the greateſt neceſſity for this liquor, that is, when the moſt frequent motions are performed, the greateſt quantity of it muſt be ſeparated. Theſe glands are ſoft and pappy, but not friable: In ſome of the large joints they are of the conglomerate kind, or a great number of ſmall glandules are wrapt up in one common membrane. Their excretory ducts are long, and hang looſe, like ſo many fringes, within the articulation; which, by its motion and preſſure, prevents obſtructions in the body of the gland or its excretories, and promotes the return of this liquor, when

when fit to be taken up by the abſorbent veſſels, which muſt be in the joints, as well as in the other cavities of the body; and, at the ſame time, the preſſure on the excretory ducts hinders a ſuperfluous unneceſſary ſecretion, while the fimbriated diſpoſition of theſe excretories does not allow any of the ſecreted liquor to be puſhed back again by theſe canals towards the glands (*a*).

Very often theſe fountains of ſlimy liquor appear only as a net-work of veſſels.—— Frequently they are almoſt concealed by cellular membranes containing the fat—and ſometimes ſmall ſimple mucous *folliculi* may be ſeen (*b*).

The different joints have theſe organs in different numbers and ſizes; the conglomerate ones don't vary much, eſpecially as to ſituation, in the ſimilar joints of different bodies; but the others are more uncertain.

Upon preſſing any of theſe glands with the finger, one can ſqueeze out of their excretories a mucilaginous liquor, which ſomewhat reſembles the white of an egg, or *ſerum* of the blood; but it is manifeſtly ſalt to the taſte. It does not coagulate by acids or by heat, as the *ſerum* does, but by the latter turns firſt thinner, and, when evaporated, leaves only a thin ſalt film.

The quantity of this *mucilage*, conſtantly ſupplied, muſt be very conſiderable, ſince we ſee what a plentiful troubleſome diſcharge of glary matter follows a wound or ulcer of any joint;

[*a*] Cowper, Anatom. explicat. tab. 79. lit. E. E.
[*b*] Morgan, Adverſar. 2. animad. 23.

joint; of which liquor the mucilage is a conſiderable part.

The veſſels which ſupply liquors for making the ſecretion of this mucilage, and the veins which bring back the blood remaining after the ſecretion, are to be ſeen without any preparation; and, after a tolerable injection of the arteries, the glands are covered with them.

In a ſound ſtate, we are not conſcious of any ſenſibility in thoſe glands; but, in ſome caſes which I have ſeen, when they inflame and ſuppurate, the moſt racking pain is felt in them: a melancholy, though a ſure proof that they have nerves.

Theſe mucilaginous glands are commonly lodged in a cellular ſubſtance; which is alſo to be obſerved in other parts of the bag formed by the ligaments of the articulation; and contains a fatty matter, that muſt neceſſarily be attenuated, and forced through the including membranes into the cavity of the joint, by the preſſure which it ſuffers from the moving bones.

If then the oil is conveyed from this cellular ſubſtance; and if the attenuated marrow paſſes from the *cancelli* of the bones by the large pores near their ends, or in their cavities, and ſweats through the cartilages there into the articulations; which it may, when aſſiſted by the conſtant heat and action of the body, more eaſily do, than when it eſcapes through the compact ſubſtance of the bones in a ſkeleton: If, I ſay, this oil is ſent to a joint,

joint, and is incorporated with the mucilage, and with the fine lymph that is conſtantly ouſing out at the extremities of the ſmall arteries diſtributed to the ligaments, one of the fitteſt *liniments* imaginable muſt be produced; for the *mucus* diluted by the lymph contributes greatly to its lubricity, and the oil preſerves it from hardening. How well ſuch a mixture ſerves the purpoſe it is deſigned for *Boyle* (*a*) tells us he experienced in working his air-pump; for the ſucker could be moved with much leſs force after being moiſtened with water and oil, than when he uſed either one or other of theſe liquors: And I believe every one, at firſt view, will allow the diluted mucilage to be much preferable to ſimple water. The *ſynovia* *, as this liquor compoſed of oil, mucilage, and lymph, is commonly now called, while in a ſound ſtate, effectually preſerves all the parts concerned in the articulations ſoft and flexible, and makes them ſlide eaſily on each other, by which their mutual detrition and overheating is prevented, in the manner daily practiſed in coach and cart wheels, by beſmearing them with greaſe and tar.

After the liquor of the articulations becomes too thin and unſerviceable, by being conſtantly pounded and rubbed between the moving bones, it is reaſſumed into the maſs of blood by the abſorbent veſſels.

When the *ſynovia* is not rubbed betwixt the bones, it inſpiſtates. And ſometimes, when the

(*a*) Phyſico-mechanic experim.

* Μυξα, mucus, axungia.

the head of a bone has been long out of its cavity, this liquor is ſaid to fill up the place of the bone, and hinder its reduction; or if a joint continues long unmoved, it is alſo ſaid to cement the bones, and occaſion a true *anchyloſis* (*a*).——If the *ſynovia* becomes too acrid, it erodes the cartilages and bones; as frequently happens to thoſe who labour under the *lues venerea*, *ſcurvy*, *ſcrophula*, or *ſpina ventoſa*.——If this liquor is ſeparated in too ſmall quantity, the joint becomes ſtiff; and when with difficulty it is moved, a crackling noiſe is heard, as people advanced in years frequently experience (*b*).—If the mucilage and lymph are depoſited in too great quantity, and the abſorbent veſſels do not perform their office ſufficiently, they may occaſion a dropſy of the joints (*c*).—From this ſame cauſe alſo the ligaments are often ſo much relaxed, as to make the conjunction of the bones very weak: Thence ariſe the luxations from an internal cauſe, which are eaſily reduced, but difficultly cured (*a*)——Frequently, when ſuch a ſuperfluous quantity of this liquor is pent up, it becomes very acrid, and occaſions a great train of bad ſymptoms; ſuch as ſwelling and pain of the joints, long ſinuous ulcers and *fiſtulæ*, rotten bones, immobility of the joints, *marcor*

(*a*) Pare, Chirurgie, livre 15. chap. 18. et livre 16. chap. 5.

(*b*) Galen de uſu part. lib. 12. cap. 2.——Fabric. ab Aquapend. de articul. part. utilitat. pars 3 ——————Bartholin. Hiſt. medic. cent. 3. hiſt. 11.

(*c*) Hildan. de ichore et meliceria acri Celſi.

(*d*) Hippocrat. de locis in homine, § 14. et de articul.

marcor and *atrophia* of the whole body, hectic fevers, &c. (*d*).—From a depravity in the blood or diſeaſes in the organs that furniſh the *ſynovia* of the joints, it may be greatly changed from its natural ſtate; it may be purulent after inflammation, mucous in the white ſwellings, gelatinous in the rheumatiſm, chalky from the gout, &c; hence a great variety of diſorders in the joints (*e*).

THE

(*d*) Hildan. de ichore et meliceria aeri Celſi.
(*e*) See Reimar Diſſert. de fungo articulor.

THE

ANATOMY

OF THE

HUMAN BONES.

PART II.

Of the SKELETON.

THOUGH any dry ſubſtance may be called *ſkeleton*, yet, among anatomiſts, this word is univerſally underſtood to ſignify the bones of animals connected together, after the teguments, muſcles, bowels, glands, nerves, and veſſels are taken away *.

A ſkeleton is ſaid to be a natural one, when the bones are kept together by their own ligaments; and it is called artificial, when the bones are joined with wire, or any other ſubſtance which is not part of the creature to which they belonged. Small ſubjects, and ſuch whoſe bones are not fully oſſified, are commonly prepared the firſt way; becauſe, were all

* Cadaveris crates.

all their parts divided, the niceſt artiſt could not rejoin them, by reaſon of their ſmallneſs; and of the ſeparation of their unoſſified parts; whereas the bones of large adult animals are ſooneſt and moſt conveniently cleaned when ſingle, and are eaſily reſtored to, and kept in their natural ſituation.—Sometimes the ſkeleton of the ſame animal is prepared in both theſe ways; that is, the ſmaller bones are kept together by their natural ligaments, and the larger ones are connected by wires, or ſome ſuch ſubſtances.

Before we proceed to the diviſion and particular deſcription of the ſkeleton, it is worth while to remark, that when the bones are put into their natural ſituation, ſcarce any one of them is placed in a perpendicular bearing to another; though the fabric compoſed of them is ſo contrived, that, in an erect poſture, a perpendicular line, from their common center of gravity, falls in the middle of their common baſe *(a)*. On this account, we can ſupport ourſelves as firmly, as if the Axis of all the bones had been a ſtreight line perpendicular to the horizon; and we have much greater quickneſs, eaſe, and ſtrength in ſeveral of the moſt neceſſary motions we perform. It is true, indeed, that wherever the bones, on which any part of our body is ſuſtained, decline from a ſtreight line, the force required in the muſcles, to counteract the gravity of that part, is greater than otherwiſe it needed

(*a*) Cowper Anat. of human bodies, explic. of tab. 87, 88.

needed to have been: But then this is effectually provided for in such places, by the number and strength of the muscles. So long therefore as we remain in the same posture, a considerable number of muscles must be in a constant state of contraction; which we know, both from reason and experience, must soon create an uneasy sensation. This we call, being weary of one posture: An inconvenience that we should not have had in standing erect, if the bearing of all the bones to each other had been perpendicular; but is more than compensated by the advantages above-mentioned.

The human skeleton is generally divided into the HEAD, the TRUNK, the SUPERIOR and the INFERIOR EXTREMITIES.

OF THE HEAD.

BY the *HEAD* is meant all that spheroidal part which is placed above the first bone of the neck. It therefore comprehends the *cranium* and bones of the *face*.

The *cranium* *, helmet, or brain case, consists of several pieces, which form a vaulted cavity, for lodging and defending the brain and *cerebellum*, with their membranes, vessels, and nerves.

The cavity of the *cranium* is proportioned to its contents. Hence such a variety of its size is observed in different subjects; and hence it is neither so broad nor so deep at its fore-part,

* Κογχος, κυτος, κωδεια, σκαφιον, calva, calvaria, cerebri galea, theca et olla capitis, testa capitis, scutella capitis.

part, in which the anterior lobes of the brain are lodged, as it is behind, where the large poſterior lobes of the brain, and the whole *cerebellum*, are contained.

The roundiſh figure of the ſcull, which makes it more capacious, and better able to defend its contents from external injuries, is chiefly owing to the equal preſſure of theſe contained parts as they grow and increaſe before it is entirely oſſified.——It is to be obſerved, however, that the ſides of the *cranium* are depreſſed below a ſpherical ſurface by the ſtrong temporal muſcles, whoſe action hinders here the uniform protruſion of the bones, which is more equally performed in other parts, where no ſuch large muſcles are. In children, whoſe muſcles have not acted much, and conſequently have not had great effects on the bones, this depreſſion is not ſo remarkable; and therefore their heads are much rounder than in adults. Theſe natural cauſes, differently diſpoſed in different people, produce a great variety in the ſhapes of ſculls, which is ſtill increaſed by the different management of the heads of children when very young: So that one may know a *Turk's* ſcull by its globular figure, a *German*'s by its breadth and flatneſs of the *occiput*, *Dutch* and *Engliſh* by their oblong ſhapes &c. *(a)*. Two advantages are reaped from this flatneſs of the ſides of the *cranium*, *viz.* the enlargement of our ſphere of viſion, and more advantageous ſituation of our ears, for receiving a greater quantity of ſound, and for being leſs expoſed to injuries.

The

(*a*) Veſal. lib. 1, c 5.

The external ſurface of the upper part of the *cranium* is very ſmooth, and equal, being only covered with the *perioſteum*, (common to all the bones; but in the ſcull, diſtinguiſhed by the name of *pericranium*), the thin *frontal* and *occipital* muſcles, their tendinous *aponeuroſis*, and with the common teguments of the body; while the external ſurface of its lower part has numerous riſings, depreſſions, and holes, which afford convenient origin and inſertion to the muſcles that are connected to it, and allow ſafe paſſage for the veſſels and nerves that run through and near it.

The internal ſurface of the upper part of the ſcull is commonly ſmooth, except where the veſſels of the *dura mater* have made furrows in it, while the bones were ſoft.——Surgeons ſhould be cautious when they trepan here, leſt, in ſawing or raiſing the bone where ſuch furrows are, they wound theſe veſſels.——In the upper part of the internal ſurface of ſeveral ſculls, there are likewiſe pits of different magnitudes and figures, which ſeem to be formed by ſome parts of the brain being more luxuriant and prominent than others. Where theſe pits are, the ſcull is ſo much thinner than any where elſe, that it is often rendered diaphanous, the two tables being cloſely compacted without a *diploe*; the want of which is ſupplied by veſſels going from the *dura mater* into a great many ſmall holes obſervable in the pits. Theſe veſſels are larger, and much more conſpicuous than any others that are ſent from the *dura mater* to the ſcull; as evidently appears from the drops of blood they pour out, when

the ſcull is raiſed from the *dura mater* in a recent ſubject; and therefore they may furniſh a ſufficient quantity of liquors neceſſary to prevent the brittleneſs of this thin part——The knowledge of theſe pits ſhould teach ſurgeons to ſaw cautiouſly and ſlowly through the external table of the ſcull, when they are performing the operation of the *trepan*; ſince, in a patient whoſe *cranium* has theſe pits, the *dura mater* and brain may be injured, before the inſtrument has pierced near the ordinary thickneſs of a table of the ſcull——The internal baſe of the ſcull is extremely unequal, for lodging the ſeveral parts and *appendices* of the brain and *cerebellum*, and allowing paſſage and defence to the veſſels and nerves that go into, or come out from theſe parts.

The bones of the *cranium* are compoſed of two tables, and intermediate *cancelli*, commonly called their *diploe* *. The external table is thickeſt; the inner, from its thinneſs and conſequently brittleneſs, has got the name of *vitrea*. Whence we may ſee the reaſon of thoſe miſchievous conſequences which ſo often attend a collection of matter in the *diploe*, either from an external or internal cauſe, before any ſign of ſuch a collection appears in the teguments that cover the part of the ſcull where it is lodged *(a)*.

The *diploe* has much the ſame texture and uſes in the ſcull, as the *cancelli* have in other bones.

The

* Meditullium, commiſſura.

(a) Bonet. Sepulchret anat. lib. 1. § 1. obſ. 96.—103.

The *diploe* of ſeveral old ſubjects is ſo obliterated, that ſcarce any veſtige of it can be ſeen; neither is it obſervable in ſome of the hard craggy bones at the baſe of the ſcull. Hence an uſeful caution to ſurgeons who truſt to the bleeding, want of reſiſtance, and change of ſound, as certain marks in the operation of the trepan, for knowing when their inſtrument has ſawed through the firſt table, and reached the *diploe* (*a*). In other people, the *diploe* becomes of a monſtrous thickneſs, while the tables of the ſcull are thinner than paper.

The *cranium* conſiſts of eight bones, ſix of which are ſaid to be proper, and the other two are reckoned common to it and to the face.—The ſix proper are the *os frontis*, two *oſſa parietalia*, two *oſſa temporum*, and the *os occipitis*——The common are the *os ethmoides* and *ſphenoides*.

The *os frontis* forms the whole fore-part of the vault; the two *oſſa parietalia* forms the upper and middle part of it; the *oſſa temporum* compoſe the lower part of the ſides; the *os occipitis* makes the whole hinder part, and ſome of the baſe; the *os ethmoides* is placed in the fore part of the baſe, and the *os ſphenoides* is in the middle of it.

Theſe bones are joined to each other by five *ſutures*; the names of which are the *coronal*, *lambdoid*, *ſagittal*, and two *ſquamous*.

The *coronal** ſuture is extended over the head, from within an inch or ſo of the exter-

(*a*) Bartholin. Anat. reform. lib. 4. cap. 4.

* Στεφαναῖα, arcualis, puppis.

nal *canthus* of one eye, to the like diſtance from the other; which being near the place where the antients wore their *vittæ*, *coronæ*, or garlands, this ſuture has hence gots its name.—Though the indentations of this ſuture are conſpicuous in its upper part, yet an inch or more of its end on each ſide has none of them; for it is ſquamous and ſmooth there.

The *lambdoidal** ſuture begins ſome way below, and farther back than the *vertex* or crown of the head, whence its two legs are ſtretched obliquely downwards, and to each ſide in form of the *Greek* letter Λ, and are now generally ſaid to extend themſelves to the *baſe*, of the ſcull; but formerly anatomiſts (*a*) reckoned the proper *lambdoid* ſuture to terminate at the *ſquamous* ſutures, and what is extended at an angle down from that on each ſide, where the indentations are leſs conſpicuous than in the upper part of the ſuture, they called *additamentum ſuturæ lambdoidis* †.

This *ſuture* is ſometimes very irregular, being made up of a great many ſmall ſutures, which ſurround ſo many little bones that are generally larger and more conſpicuous on the external ſurface of the ſcull, than internally. Theſe bones are generally called *triquetra* or *Wormiana*; but ſome other name ought to be given them, for they are not always of a triangular

* Laudæ, proræ, hypſyloides.

(*a*) Veſal. Anat. lib. 1. cap. 6.

† Lambdoides harmonialis, lambdoides inferior, occipitis corona.

gular figure; and older anatomiſts *(a)* than *Olaus Wormius* (*b*) have deſcribed them.—The ſpecific virtue which theſe bones were once thought to have in the cure of the epilepſy (*c*) is not now aſcribed to them; and anatomiſts generally agree, that their formation is owing to a greater number of points than ordinary of oſſification in the ſcull, or to the ordinary bones of the *cranium* not extending their oſſification far enough or ſoon enough; in which caſe, the unoſſified interſtice between ſuch bones begins a ſeparate oſſification in one or more points: from which the oſſification is extended to form as many diſtinct bones as there were points that are indented into the large ordinary bones, and into each other.—Probably thoſe children who have a large opening in this place at their birth, will have the largeſt *oſſa triquetra*.——To confirm this account of the formation of theſe little bones, we may remark, that ſuch bones are ſometimes ſeen in other ſutures, as well as in the *lambdoid* (*d*), and they are ſometimes in one table of the ſcull, and not in the other *(e)*.

The *ſagittal* ſuture * is placed longitudinally in the middle of the upper part of the ſcull,

(*a*) Euſtach. Oſſium examen.—Bauhin. Theat. anat. lib. 3. cap. 5. Paaw in Hippocrat. de vulner. cap. p. 56.

(*b*) Muſæum, lib. 3. cap. 26.

(*c*) Bauhin. et Paaw. ibid. Bartholin. Anat. reform. lib. 4. cap. 5.—Hildan. Epiſtol. 65.

(*d*) See examples in Veſal. lib. 1. cap. 6. fig. 4.—Paaw in Hippocrat. de cap. vuln.—Bartholin. Hiſt. anat. cent. 1. hiſt. 51.—Ruſch. Muſ. anat.—Sue Trad. d'Oſteolog. p. 47.

(*e*) Hunald. in Mem. de l'acad. des ſciences, 1730.

* Ῥαβδοειδὴς, ὀθελαία, ἐπιζευγνυσα, Inſtar virgae, nervalis, inſtar teli, inſtar veru, ſecundum capitis longitudinem prorepens, conjungens, columnalis, recta, acualis.

and commonly terminates at the middle of the *coronal*, and of the *lambdoid* ſutures; between which it is ſaid to be placed, as an arrow is between the ſtring and bow.—However this ſuture is frequently continued through the middle of the *os frontis*, down to the root of the noſe; which, ſome (*a*) ſay, oftener happens in women than men; but others (*b*) alledge, that it is to be met with more frequently in male ſculls than in female: Among the ſculls, which I have ſeen thus divided, the female are the moſt numerous.—Several (*c*) have delineated and deſcribed the *ſagittal* ſuture, ſometimes dividing the *occipital* bone as far down as the great hole through which the *medulla ſpinalis* paſſes. This I never ſaw.

In ſome old ſculls that are in my poſſeſſion, there is ſcarce a veſtige of any of the three *ſutures* which I have now deſcribed. In other heads, one or two of the ſutures only diſappear; but I never could diſcover any reaſon for thinking them diſpoſed in ſuch different manners in ſculls of different ſhapes, as ſome antients alledge they are (*d*).

The *ſquamous agglutinations*, or *falſe ſutures* †, are one on each ſide, a little above the ear, of a ſemicircular figure, formed by the over-

(*a*) Riolan. Comment. de offib. cap. 8.

(*b*) Veſal. lib. 1. cap. 6. et in epitome.

(*c*) Veſal. lib. 1. cap. 5. fig. 3. 4. et in text cap. 6.—Paaw in Celſ. de re medic. cap. 1.—Laurent. Hiſt. anat. lib. 2. cap. 16.

(*d*) Hippocrat. de vulner. capitis, § 1.—Galen. de offib. et de uſu part. lib. 9. cap. 17.

† Λεπιδοειδῆ, προσκολλήματα, κροταφίαι, temporales, corticales, mendoſæ, harmoniales, commiſſuræ in unguem.

overlopping (like one ſcale upon another) of the upper part of the *temporal* bones on the lower part of the *parietal*, where, in both bones, there are a great many ſmall riſings and furrows, which are indented into each other; though theſe inequalities do not appear till the bones are ſeparated. In ſome ſculls indeed the indentations here are as conſpicuous externally as in other ſutures (*a*); and what is commonly called the poſterior part of this ſquamous ſuture, always has the evident ſerrated form; and therefore is reckoned by ſome (*b*), a diſtinct ſuture, under the name of *additamentum, poſterius ſuturæ ſquamoſæ.*——I have ſeen too ſquamous ſutures on the ſame temple, with a ſemicircular piece of bone between them (*c*).

We ought here to remark, that the true ſquamous ſort of ſuture is not confined to the conjunction of the temporal and parietal bones, but is made uſe of to join all the edges of the bones on which each temporal muſcle is placed (*d*): For the two parts of the ſphenoidal ſuture which are continued from the anterior end of the common ſquamous ſuture juſt now deſcribed, of which one runs perpendicularly downwards, and the other horizontally forwards, and alſo the lower part of the coronal ſuture already taken notice of, may all be juſtly ſaid to

(*a*) Colomb. de re anat. lib. 1. cap. 4.—Dionis, Anat. 3. demonſt. des os.

(*b*) Albin. de oſſib. § 54.

(*c*) Sue Trad. d'oſteolog. p. 48.

(*d*) Veſal. Anat. lib. 1. cap. 6.—Winſlow, Mem. de l'acad. des ſciences, 1720.

pertain to the ſquamous *ſuture*—The manner how I imagine this ſort of ſuture is formed at theſe places, is, That, by the action of the ſtrong temporal muſcles on one ſide, and by the preſſure of the brain on the other, the bones are made ſo thin, that they have not large enough ſurfaces oppoſed to each other to ſtop the extenſion of their fibres at length, and thus to cauſe the common ſerrated appearance of ſutures explained in p. 39, but the narrow edge of the one bone ſlides over the other. The *ſquamous* form is alſo more convenient here; becauſe ſuch thin edges of bones, when accurately applied one to another, have ſcarce any rough ſurface, to obſtruct or hurt the muſcle in its contraction; which is ſtill further provided for, by the manner of laying theſe edges on each other; for, in viewing their outſide, we ſee the temporal bones covering the ſphenoidal and parietal, and this laſt ſupporting the ſphenoidal, while both mount on the frontal; from which diſpoſition it is evident, that while the temporal muſcle is contracting, which is the only time it preſſes ſtrongly in its motion on the bones, its fibres ſlide eaſily over the external edges. Another advantage ſtill in this is, that all this bony part is made ſtronger by the bones thus ſupporting each other.

The bones of the ſcull are joined to thoſe of the face, by *ſchyndeleſis* and *ſutures*.—The *ſchyndeleſis* is in the partition of the noſe.—The ſutures ſaid to be common to the *cranium* and face are five, *viz.* the *ethmoidal*, *ſphenoidal*, *tranſverſe*, and two *zygomatic*.—Parts however

ever of these sutures are at the junction of only the bones of the scull.

The *ethmoidal* and *sphenoidal* sutures surround the bones of these names; and in some places help to make up other sutures, particularly the *squamous* and *transverse*; and in other parts there is but one suture common to these two bones.

The *transverse* suture is extended quite cross the face, from the external *canthus* of one orbit to the same place of the other, by sinking from the *canthus* down the outside of the orbit to its bottom; then mounting upon its inside, it is continued by the root of the nose down the internal part of the other orbit, and rises up again on its outside to the other *canthus*. It may be here remarked, that there are some interruptions of this suture in the course I have described; for the bones are not contiguous every where, but are separated, to leave holes and apertures, to be mentioned hereafter.

The *zygomatic* sutures are one on each side, being short, and slanting from above obliquely downwards and backwards, to join a process of the cheek-bone to one of the *temporal* bones, which advances towards the face; so that the two processes thus united, form a sort of bridge, or *jugum*, under which the *temporal* muscle passes; on which account the processes, and suture joining them, have been called *zygomatic*.

It must be observed, that the indentations of the *sutures* do not appear on the inside of the *cranium*, by much so strong as on the out-side; but the bones seem almost joined in a streight

line: nay, in ſome ſculls, the internal ſurface is found entire, while the ſutures are manifeſt without; which may poſſibly be owing to the leſs extent of the concave than of the convex ſurface of the *cranium*, whereby the fibres of the internal ſide would be ſtretched farther out at the edges of the bones, than the exterior ones, if they were not reſiſted. The reſiſtances are the fibres of the oppoſite bone, the parts within the ſcull, and the *diploe*; of which the laſt being the weakeſt, the moſt advanced fibres or *ſerræ* run into it, and leave the contiguous edges equal, and more ready to unite: whereas the *ſerræ* of the external table have ſpace enough for their admiſſion between the fibres of the oppoſite bone, and therefore remain of the indented form, and are leſs liable to the concretion, whereby the ſutures are obliterated *(a)*.——By this mechaniſm, there is no riſk of the ſharp points of the bones, growing inwards, ſince the external *ſerræ* of each of the conjoined bones reſt upon the internal ſmooth-edged table of the other; and external forces applied to theſe parts are ſtrongly reſiſted, becauſe the ſutures cannot yield, unleſs the ſerrated edges of the one bone, and the plain internal plate of the other are broken *(b)*.

The advantages of the ſuture of the *cranium* are theſe: 1. That this *capſula* is more eaſily formed and extended into a ſpherical figure, than if it had been one continued bone.

2. That

(*a*) Hunauld, Memoires de l'acad. des ſciences, 1730.
(*b*) Winſlow, Memoires de l'acad. des ſciences, 1720.

2. That the bones which are at ſome diſtance from each other at birth, might then yield, and allow to the head a change of ſhape, accommodated to the paſſage it is engaged in. Whence, in hard labour of child-bed, the bones of the *cranium*, inſtead of being only brought into contact, are ſometimes made to mount one upon the other. 3. It is alledged, that, thro' the ſutures, there is a tranſpiration of ſteams from the brain, which was the old doctrine; or ſome communications of the veſſels without, and of thoſe within the ſcull, larger here than in any other part of the *cranium*, according to ſome moderns; and therefore *cucuphæ*, *fomentations*, *cataplaſms*, *cephalic plaiſters*, *bliſters*, are applied, and *iſſues* are eroded, or cut in the head, at thoſe places where the ſutures are longeſt in forming, and where the connection of the bones is afterwards looſeſt, for the cure of a *phrenitis*, *mania*, *inveterate head-ach*, *epilepſy*, *apoplexy*, and other diſeaſes of the head. The favourers of the doctrine of tranſpiration, or communication of veſſels at the ſutures, endeavour to ſupport it by obſervations of perſons ſubject to head-achs which cauſed death, from the ſutures being too cloſely united *(a)*. 4. That the *dura mater* may be more firmly ſuſpended by its proceſſes, which inſinuate themſelves into this conjunction of the bones; for doing this equally, and where the greateſt neceſſity of adheſion is, the ſutures are diſpoſed at nearly equal

(a) Columb. de re anat. lib. 1. cap. 5.——Verduc. nouvelle oſteologie, chap. 14.——Dionis, Anat. 3. demonſtr. des os.

equal distances, and the large *reservoirs* of blood, the *sinuses*, are under or near them. 5. That fractures might be prevented from reaching so far as they would in a continued bony substance. 6. That the connection at the sutures being capable of yielding, the bones might be allowed to separate; which has given great relief to patients from the violent symptoms which they had before this separation happened *(a)*. And it seems reasonable to believe, that the opening of the sutures was of great benefit to several others who were rather judged to have been hurt by it *(b)*: for we must think, that the consequences of such a force acting upon the brain, as was capable of thrusting the bones asunder, must have been fatal, unless it had been thus yielded to.

Having gone through the general structure of the *cranium*, I now proceed to examine each bone of which that brain-case consists, in the order in which I first named them.

The *OS FRONTIS* † has its name from its being the only bone of that part of the face we call the *forehead*, though it reaches a good deal further. It has some resemblance in shape to the shell of the *concha bivalvis*, commonly called

(*a*) Ephemerid. Germanic. dec. 1. ann. 4. et 5. observ. 33.

(*b*) Ephemerid. Germ. dec. 2. ann. 9. obs. 230. Ibid. cent. 10. obs. 31.—Vander Linden Medicin. phys. cap. 8. art. 4. § 16.—Hildan. Observ. cent. 1. obs. 1. cent. 2. obs. 7.—Bauhin. Theat. anat. lib. 3. cap. 6.—Pechlin. Observ. lib. 2. observ. 39.

† Μετωπον, Βρεγμα, coronale, inverecundum, puppis, sensus communis, sincipitis.

called the *cockle*; for the greateſt part of it is convex externally, and concave internally, with a ſerrated circular edge; while the ſmaller part has proceſſes and depreſſions, which make it of an irregular figure.

The external ſurface of the *os frontis* is ſmooth at its upper convex part; but ſeveral proceſſes and cavities are obſervable below; for, at each angle of each orbit, the bone jutts out, to form four proceſſes, two internal, and as many external; which, from this ſituation, may well enough be named *angular*. Between the internal and external angular proceſſes of each ſide, an arched ridge is extended, on which the eye brows are placed.—Very little above the internal end of each of theſe *ſuperciliary* ridges, a protuberance may be remarked, in moſt ſculls, where there are large cavities, called *ſinuſes*, within the bone; of which hereafter.—Betwixt the internal angular proceſſes, a ſmall proceſs riſes, which forms ſome ſhare of the noſe, and thence is named *naſal*.—Some obſerve a protuberant part on the edge of the bone behind each external angular proceſs, which they call *temporal* proceſſes; but theſe are inconſiderable.—From the under part of the ſuperciliary ridges, the frontal bone runs a great way backwards; which parts may juſtly enough be called *orbitar* proceſſes. Theſe, contrary to the reſt of this bone, are concave externally, for receiving the globes of the eyes, with their muſcles, fat, *&c.*

In each of the *orbitar* proceſſes, behind the middle of the ſuperciliary ridges, a conſiderable ſinuoſity is obſerved, where the *glandula*

innominata Galeni or *lachrymalis* is lodged.—Behind each internal angular proceſs, a ſmall pit may be remarked, where the cartilaginous pully of the *muſculus obliquus major* of the eye is fixed.—Betwixt the two orbitar proceſſes, there is a large diſcontinuation of the bone, into which the cribriform part of the *os ethmoides* is incaſed.—The frontal bone frequently has little caverns formed in it here where it is joined to the ethmoid bone.—Behind each external angular proceſs, the ſurface of the frontal bone is conſiderably depreſſed where part of the *temporal* muſcle is placed.

The *foramina*, or holes, obſervable on the external ſurface of the frontal bone, are three in each ſide.——One in each ſuperciliary ridge, a little removed from its middle towards the noſe; through which a twig of the *ophthalmic* branch of the fifth pair of nerves paſſes out of the orbit, with a ſmall artery from the internal carotid, to be diſtributed to the teguments and muſcles of the forehead.—Theſe veſſels in ſome ſculls make furrows in the *os frontis*, eſpecially in the bones of children, as has alſo been obſerved of another conſiderable veſſel of this bone near its middle (*a*); and therefore we ought to beware of tranſverſe inciſions on either ſide of the *os frontis*, which might either open theſe veſſels or hurt the nerves, while they are yet in part within the bone; for, when veſſels are thus wounded, it is difficult to ſtop the hæmorrhagy, becauſe the adheſion of a part of the artery to the bone hinders its contraction,

(*a*) Ruyſch. Muſ. anat. theca. D. repoſit. 3. No. 3.

contraction, and consequently styptics can have little effect; the sides of the furrow keep off compressing substances from the artery; and we would wish to shun cauteries or escharotics, because they make the bone carious; and nerves, when thus hurt, sometimes produce violent symptoms.—But, to return to the *superciliary foramina*, we must remark, that often, instead of a hole, a notch only is to be seen: Nay, in some sculls, scarce a vestige even of this is left; in others, both hole and notch are observable, when the nerve and artery run separately. Frequently a hole is found on one side, and a notch on the other; at other times we see two holes; or there is a common hole without, and two distinct entries internally. The reason of this variety of a hole, notch, depression, or smoothness in the superciliary ridge, is the different length and tension of the nerves and vessels; the shorter they are, the more they are sunk into the bone as it grows.—Near the middle of the inside of each orbit, hard by, or in the *transverse suture*, there is a small hole for the passage of the nasal twig of the first branch of the fifth pair of nerves, and of a branch of the ophthalmic artery. This hole is sometimes entirely formed in the *os frontis*; in other sculls, the sides of it are composed of this last bone, and of the *os planum*. It is commonly known by the name of *orbitarium internum*, though *anterius* should be added, because of the next, which is commonly omitted.—This, which may be called *orbitarium internum posterius*, is such another as the former; only smaller, and about an inch

inch deeper in the orbit; through it a ſmall branch of the ocular artery paſſes to the noſe.—Beſides theſe ſix, there are a great number of ſmall holes obſervable on the outer ſurface of this bone, particularly in the two protuberances above the eye-brows. Moſt of theſe penetrate no further than the *ſinuſes*, or than the *diploe*, if the *ſinuſes* are wanting; though ſometimes I have ſeen this bone ſo perforated by a vaſt number of theſe ſmall holes, that, placed between the eye and a clear light, it appeared like a ſieve.—In the orbit of the generality of *ſkeletons*, we may obſerve one, two, or more holes, which allow a paſſage to a hog's briſtle through the ſcull. The place, ſize, and number of theſe, are however uncertain: They generally ſerve for the tranſmiſſion of ſmall arteries or nerves.

The internal ſurface of the *os frontis* is concave, except at the orbitar proceſſes, which are convex to ſupport the anterior lobes of the brain. This ſurface is not ſo ſmooth as the external; for the larger branches of the arteries of the *dura mater* make ſome furrows in its ſides and back parts. The ſinuoſities from the luxuriant riſings of the brain, mentioned when deſcribing the general ſtructure of the *cranium*, are often very obſervable on its upper part; and its lower and fore parts are marked with the contorſions of the anterior lobes of the brain.—Through the middle of this internal ſurface, where always in children, and ſometimes in old people, the bone is divided, either a ridge ſtands out, to which the upper edge of the *falx* is faſtened, or a furrow runs, in which

which the upper ſide of the ſuperior longitudinal *ſinus* is lodged; on both theſe accounts chirurgical authors juſtly diſcharge the application of the trepan here.—The reaſon of this difference in ſculls, is alledged by ſome authors to be this, That in thin ſculls the ridge ſtrengthens the bones, and in thick ones there is no occaſion for it. To this way of accounting for this phænomenon, it may juſtly be objected, that generally very thick ſculls have a large ſpine here, and frequently thin ones have only a furrow. Perhaps this variety may be owing to the different times of compleat oſſification of thoſe parts in different ſubjects: For if the two ſides of this bone meet before they arrive at their utmoſt extent of growth, they unite very firmly, and all their fibres endeavour to ſtretch themſelves out where the leaſt reſiſtance is, that is, between the hemiſpheres of the brain. To ſupport this reaſoning, we may remark, that thoſe adults, whoſe frontal bone is divided by the ſagittal ſuture, never have a ridge in this place.

Immediately at the root of this ridge or furrow there is a ſmall hole, which ſometimes pierces through the firſt table, and, in other ſculls, opens into the ſuperior *ſinus* of the *ethmoid* bone within the noſe. In it a little proceſs of the *falx* is lodged, and a ſmall artery, and ſometimes a vein, runs *(a)*; and the ſuperior longitudinal *ſinus* begins here.—This hole, however, is often not entirely proper to the *os frontis*; for in ſeveral ſculls, the lower part of it is formed in the upper part of the baſe of the

criſta

(*a*) Morgagn. Adverſar. 6. animad. 31.

criſta galli, which is a proceſs of the *ethmoid* bone (*a*).

The *os frontis* is compoſed of two tables, and an intermediate *diploe*, as the other bones of the *cranium* are, and, in a middle degree of thickneſs between the *os occipitis* and the *parietal* bones, is pretty equally denſe all through, except at the orbitar proceſſes, where, by the action of the eye on one ſide, and preſſure of the lobes of the brain on the other, it is made extremely thin and diaphanous, and the *meditullium* is entirely obliterated. Since in this place there is ſo weak a defence for the brain, the reaſon appears why fencers eſteem a puſh in the eye mortal (*b*).

The *diploe* is alſo exhauſted in that part above the eye-brows, where the two tables of the bone ſeparate, by the external being protruded outwards, to form two large cavities, called *ſinus frontales*.—Theſe are divided by a middle perpendicular bony partition.—Their capacities in the ſame ſubject are ſeldom equal; in ſome the right, in others the left is largeſt.—And in different bones their ſize is as inconſtant; nay, I have examined ſome, where they were entirely wanting; which oftener happens in ſuch as have a flat forehead, and whoſe ſagittal future is continued down to the noſe, than in others (*c*).—In ſome ſculls, beſides the large perpendicular *ſeptum*, there are ſeveral bony

(*a*) Ingraſſ. Comment. in Galen. de offib. cap. 1. comment. 8.

(*b*) Ruyſch. Obſerv. anat. chir. obſerv. 54.—Diemerbroeck. Anat. lib. 3. cap. 10.—Bonet. Sepulch. anat. lib. 4. § 3. obſerv. 17.

(*c*) Fallop. Expoſit. de offibus. cap. 13.

bony pillars, or ſhort partitions, found in each *ſinus*; in others theſe are wanting——For the moſt part the *ſeptum* is entire; at other times it is diſcontinued, and the two *ſinuſes* communicate.—When the *ſinuſes* are ſeen in ſuch ſculls as have the frontal bone divided by the ſagittal ſuture, the partition dividing theſe cavities is evidently compoſed of two plates, which eaſily ſeparate.—Each *ſinus* commonly opens by a roundiſh ſmall hole, at the inner and lower part of the internal angular proceſſes, into a *ſinus* formed in the noſe, at the upper and back part of the *os unguis*; near to which there are alſo ſome other ſmall *ſinuſes* of this bone (*a*), the greater part of which opens ſeparately nearer the *ſeptum narium*, and often they terminate in the ſame common canal with the large ones.

In a natural and ſound ſtate, theſe cavities are of a conſiderable advantage; for the organ of ſmelling being thus enlarged, the *effluvia* of odorous bodies more difficultly eſcape it; and their impreſſions being more numerous, are therefore ſtronger, and affect the organ more. That odorous particles may be applied to the membrane of the *ſinuſes*, is evident from the pain felt in this part of the forehead, when the *effluvia* of volatile ſpirits, or of ſtrong aromatics, are drawn up into the noſe by a quick inſpiration.——————Theſe and the other cavities which open into the noſe, increaſe the ſound of our voice, and render it more melodious, by ſerving as ſo many vaults to reſound the notes. Hence people labouring under a *coryza*, or ſtoppage of the noſe from any other

(*a*) Cowper in Drake's Anthropolog. book 3. chap. 10.

ther cauſe, when they are by the vulgar, though falſely, ſaid to ſpeak through their noſe, have ſuch a diſagreeable harſh voice.—The liquor ſeparated in the membrane of theſe ſinuſes, drills down upon the membrane of the noſe to keep it moiſt.

From the deſcription of theſe *ſinuſes*, it is evident, how uſeleſs, nay, how pernicious it muſt be, to apply a trepan on this part of the ſcull; for this inſtrument, inſtead of piercing into the cavity of the *cranium*, would reach no further than the *ſinuſes*; or, if the inner table was perforated, any extravaſated blood that happened to be within the ſcull, would not be diſcharged outwardly, but would fall into the *ſinuſes*, there to ſtagnate, corrupt, and ſtimulate the ſenſible membranes; from which alſo there would be ſuch a conſtant flow of glairy mucus, as would retard, if not hinder a cure, and would make the ſore degenerate into an incurable *fiſtula*. Beſides, as it would be almoſt impoſſible in this caſe to prevent the air, paſſing through the noſe, from having conſtant acceſs to the *dura mater*, or brain; ſuch a corruption would be brought on theſe parts, as would be attended with great danger. Further, in reſpiration, the air ruſhing violently into theſe cavities of the *os frontis*, and paſſing through the external orifice, whenever it was not well covered and defended, would not only prevent the cloſing up of the external orifice, but might otherwiſe bring on bad conſequences (*a*).——The membrane lining theſe *ſinuſes*

(*a*) Paaw. de Oſſibus. pars. 1. cap. 7.—Palfyne Anatom. chir. traite 4. chap. 15. Nouvelle oſteologie, partie 2, chap. 3.

ſinuſes is ſo ſenſible, that inflammations of it muſt create violent torture (*a*): and worms, or other inſects crawling there, muſt give great uneaſineſs (*b*).

The upper circular part of the *os frontis*, is joined to the *oſſa parietalia*, from one temple to the other, by the coronal ſuture. From the termination of the coronal ſuture to the external angular proceſſes, this bone is connected to the *ſphenoid* by the *ſphenoidal* ſuture. At the external *canthi* of the eyes, its angular proceſſes are joined by the tranſverſe ſuture to the *oſſa malarum*, to which it adheres one third down the outſide of the orbits; whence to the bottom of theſe cavities, and a little up on their internal ſides, theſe orbitar proceſſes are connected to the *ſphenoidal* bone by that ſame ſuture.—In ſome few ſculls, however, a diſcontinuation of theſe two bones appears at the upper part of the long ſlit, near the bottom of the orbit.—On the inſide of each orbit, the orbitar proceſs is indented between the *cribriform* part of the *ethmoid* bone, and the *os planum* and *unguis*.—The tranſverſe ſuture afterwards joins the frontal bone to the ſuperior naſal proceſſes of the *oſſa maxillaria ſuperiora*, and to the naſal bones. And, *laſtly*, its naſal proceſs is connected to the naſal *lamella* of the *ethmoid* bone.

The

(*a*) Fernel. Partholog. lib. 5. cap. 7.——Saltzman Decur. obſerv. 10.

(*b*) Fernel. Partholog. lib. 5. cap. 7.—Bartholin. Epiſtol. medic. cent. 2. epiſt. 74.——Hiſt. de l'acad. des ſciences, 1708 & 1733.

The *frontal* bone ſerves to defend and ſupport the anterior lobes of the brain. It forms a conſiderable part of the cavities that contain the globes of the eyes, helps to make up the *ſeptum narium*, organ of ſmelling, *&c.* From the deſcription of the ſeveral parts, the other uſes of this bone are evident.

In a ripe child, the frontal bone is divided through the middle; the ſuperciliary holes are not formed; often a ſmall round piece of each orbitar proceſs, behind the ſuperciliary ridge, is not oſſified, and there is no *ſinus* to be ſeen within its ſubſtance.

Each of the two *OSSA PARIETALIA**, or bones ſerving as walls to the *encephalon*, is an irregular ſquare; its upper and fore ſides being longer than the one behind or below. The inferior ſide is a concave arch; the middle part receiving the upper round part of the temporal bone.—The angle formed by this upper ſide, and the fore one, is ſo extended, as to have the appearance of a proceſs.

The external ſurface of each *os parietale* is convex. Upon it, ſomewhat below the middle heighth of the bone, there is a tranſverſe arched ridge, of a whiter colour generally than any other part of the bone; from which, in bones that have ſtrong prints of muſcles, we ſee a great many converging furrows, like ſo many *radii* drawn from a circumference towards a center. From this ridge of each bone the temporal muſcle riſes; and, by the preſſure of its fibres, occaſions the furrows juſt now mentioned.

* Κορυφῆς, paria, ſyncipitis, verticis, arcualia, nervalia, cogitationis, rationis, bregmatis, madefactionis.

mentioned.——Below theſe, we obſerve, near the ſemicircular edges, a great many riſings and depreſſions, which are joined to like inequalities on the inſide of the temporal bone, to form the ſquamous ſuture. The temporal bone may therefore ſerve here as a buttreſs, to prevent the lower ſide of the parietal from ſtarting outwards when its upper part is preſſed or ſtruck *(a)*.

Near the upper ſides of theſe bones, towards the hind part, is a ſmall hole in each, through which a vein paſſes from the teguments of the head to the longitudinal *ſinus*. Sometimes I have ſeen a branch of the temporal artery paſs through this hole, to be diſtributed to the upper part of the *falx*, and to the *dura mater* at its ſides, where it had frequent anaſtomoſes with the branches of the arteries derived from the external carotids, which commonly have the name of the arteries of the *dura mater*, and with the branches of the internal carotids which ſerve the *falx*.—In ſeveral ſculls, one of the *oſſa parietalia* has not this hole; in others, there are two in one bone; and in ſome not one in either. Moſt frequently this hole is through both tables; at other times the external table is only perforated.—The knowledge of the courſe of theſe veſſels, may be of uſe to ſurgeons, when they make any inciſion near this part of the head, leſt, if the veſſels are raſhly cut near the hole, they ſhrink within the ſubſtance of the bone, and ſo cauſe an obſtinate hæmorragy, which neither ligatures nor medicines can ſtop.

On

(*a*) Hunauld. in Mem. de l'acad. des ſciences, 1730.

On the inner concave ſurface of the parietal bones, we ſee a great many deep furrows, diſpoſed ſomewhat like the branches of trees: The furrows are largeſt and deepeſt at the lower edge of each *os parietale*, eſpecially near its anterior angle, where ſometimes a full canal is formed. They afterwards divide into ſmall furrows, in their progreſs upwards.—In ſome ſculls a large furrow begins at the hole near the upper edge, and divides into branches, which join with thoſe which come upwards, ſhewing the communications of the upper and lower veſſels of the *dura mater*.—In theſe furrows we frequently ſee paſſages into the *diploe*; and ſometimes I have obſerved canals going off, which allowed a ſmall probe to paſs ſome inches into the bony ſubſtance. Some (*a*) tell us, that they have obſerved theſe canals piercing the bone towards the *occiput*.—On the inſide of the upper edge of the *oſſa parietalia*, there is a large ſinuoſity, frequently larger in the bone of one ſide than of the other, where the upper part of the *falx* is faſtened, and the ſuperior longitudinal *ſinus* is lodged.—Generally part of the lateral *ſinuſes* make a depreſſion near the angle, formed by the lower and poſterior ſides of theſe bones; and the pits made by the prominent parts of the brain are to be ſeen in no part of the ſcull more frequent, or more conſiderable, than in the internal ſurface of the parietal bones.

The *oſſa parietalia* are amongſt the thinneſt bones of the *cranium*; but enjoy the general ſtructure

(*a*) Cowper. Anatom. explic. of 90. tab. fig. 2.

ſtructure of two tables and *diploe* the compleſt, and are the moſt equal and ſmooth.

Theſe bones are joined at their fore-ſide to the *os frontis* by the coronal ſuture; at their long inferior angles, to the *ſphenoid bone*, by part of the ſuture of this name; at their lower edge to the *oſſa temporum*, by the ſquamous ſuture, and its poſterior *additamentum*; behind, to the *os occipitis*, or *oſſa triquetra*, by the lambdoid ſuture; and above, to one another, by the ſagittal ſuture.

They have no particular uſes beſides thoſe mentioned in the deſcription of their ſeveral parts, except what are included in the account of the general ſtructure of the *cranium*.

In a child born at the full time, none of the ſides of this bone are completed; and there never is a hole in the oſſified part of it near to the ſagittal ſuture.

The large unoſſified ligamentous part of the *cranium* obſervable between the parietal bones, and the middle of the divided *os frontis* of new-born children, called by the vulgar the *open of the head*, was imagined by the antients to ſerve for the evacuation of the ſuperfluous moiſture of the brain: and therefore they named it *bregma* *, or the fountain; ſometimes adding the epiphet *pulſatilis*, or beating, on account of the pulſation of the brain felt through this flexible ligamento-cartilaginous ſubſtance. Hence very frequently the parietal bones are called *oſſa bregmatis*.

The upper middle part of the head of a child, in a natural birth, being what preſents itſelf

* Palpitans vertex, foliolum, folium, triangularis lacuna.

itſelf firſt at the *os uteri* (*a*), an accoucheur may reach the *bregma* with his finger, when the *os uteri* is a little opened. If the *bregma* is ſtretched, and the pulſation of the brain is felt through it, the child is certainly alive: But if it is ſhrivelled and flaccid, without any obſervable pulſation in it, there is ſome reaſon to ſuſpect the child to be very weak, or dead. Thoſe who practiſe midwifery ſhould therefore examine the ſtate of the *bregma* accurately.

All the *bregma* is generally oſſified before ſeven years of age. Several authors (*b*) ſay, they have obſerved it unoſſified in adults; and phyſicians, who order the application of medicines at the meeting of the coronal and ſagittal ſutures, ſeem yet to think that a derivation of noxious humours from the *encephalon* is more eaſily procured at this part than any other of the ſcull; and that medicines have a greater effects here, than elſewhere, in the internal diſorders of the head.

*OSSA TEMPORUM**, ſo named, ſay authors, from the hair's firſt becoming gray on the temples, and thus diſcovering peoples ages, are each of them equal and ſmooth above, with a very thin ſemicircular edge; which, from the manner of its connection with the neighbouring bones, is diſtinguiſhed by the name

(*a*) Burton's Midwifery, § 51.——Smellie's Midwifery, book 1. chap. 1. § 5.

(*b*) Bartholin. Anat. reform. lib. 4. cap. 6.—— Diemerbroek, Anat. lib. 9. cap. 6.——Kerkring. Oſteogen. cap. 2.

* Κόρταφῶν. κορτῶν, κοῤῥῶν, λεπιδοειδῆ, πολυειδῆ, λιθοειδῆ temporalia, lapidoſa, mendoſa, dura, arcualia, tymparum, armalia, ſaxea, parietalia.

name of *os ſquamoſum*.—Behind this, the upper part of the temporal bone is thicker, and more unequal, and is ſometimes deſcribed as a diſtinct part, under the name of *pars mammillaris (a)*.—Towards the baſe of the ſcull, the temporal bone appears very irregular and unequal; and this part, inſtead of being broad, and placed perpendicularly, as the others are, is contracted into an oblong very hard ſubſtance, extended horizontally forwards and inwards, which in its progreſs becomes ſmaller, and is commonly called *os petroſum*.

Three external proceſſes of each temporal bone are generally deſcribed—The firſt placed at the lower and hind part of the bone, from its reſemblance to a nipple, is called *maſtoides*, or *mammillaris*. It is not ſolid, but within is compoſed of *cancelli*, or ſmall cells, which have a communication with the large cavity of the ear, the drum; and therefore ſounds, being multiplied in this vaulted labyrinth, are increaſed, before they are applied to the immediate organ of hearing. Into the maſtoid proceſs, the *ſtenomaſtoideus* muſcle is inſerted; and to its back part, where the ſurface is rough, the *trachelomaſtoideus*, and part of the *ſplenius* are fixed.—About an inch farther forward, the ſecond proceſs begins to riſe out from the bone; and having its origin continued obliquely downwards and forwards for ſome way, it becomes ſmaller, and is ſtretched forwards to join with the *os malæ*; they together forming the bony *jugum*, under which the temporal muſcle paſſes.

(*a*) Albin. de oſſib. § 26.

Hence this proceſs has been named *zygomatic* *. Its upper edge has the ſtrong aponeuroſis of the *temporal* muſcle fixed into it; and its lower part gives riſe to a ſhare of the *maſſeter*.—— The fore-part of the baſe of this proceſs is an oblong tubercle, which in a recent ſubject is covered with a ſmooth poliſhed cartilage, continued from that which lines the cavity immediately behind this tubercle.——From the under craggy part of the *os temporum*, the third proceſs ſtands out obliquely forwards. The ſhape of it is generally ſaid to reſemble the ancient *ſtylus ſcriptorius*; and therefore it is called the *ſtyloid* proceſs †. Some authors (*a*) however contend, that it ought to be named *ſteloid*, from its being more like to a pillar. Several muſcles have their origin from this proceſs, and borrow one half of their name from it; as *ſtylo-gloſſus*, *ſtylo-hyoideus*, *ſtylo-pharyngeus*; to it a ligament of the *os hyoides*, is ſometimes fixed: and another is extended from it to the inſide of the angle of the lower jaw. This proceſs is often even in adults not entirely oſſified, but is ligamentous at its root, and ſometimes is compoſed of two or three diſtinct pieces.—Round the root of it, eſpecially at the fore-part, there is a remarkable riſing of the *os petroſum*, which ſome have eſteemed a proceſs; and, from the appearance

* Καγχρος, paris, anſæ oſſium temporum, oſſa arcualia, paria, jugalia, conjugalia.

† Γραιφοειδη, βελονοειδη, πληκτρον, os calaminum, ſagittale, clavale, acuale, calcar capitis.

(*a*) Galen, de uſu part. lib. 2. cap. 4.—Fallop. Obſerv. anatom.

pearance it makes with the *ſtyliform*, have named it *vaginalis*.—Others again have, under the name of *auditory* proceſs, reckoned among the external proceſſes that ſemicircular ridge, which, running between the root of the *maſtoid* and *zygomatic* proceſſes, forms the underpart of the external *meatus auditorius*.

The ſinuoſities or depreſſions on the external ſurface of each *os temporum* are theſe:—A long *foſſa* at the inner and back part of the root of the mammary proceſs, where the poſterior head of the *digaſtric* muſcle has its origin.——Immediately before the root of the *zygomatic* proceſs, a conſiderable hollow is left, for lodging the *crotaphite* muſcle.—Between the *zygomatic*, *auditory*, and *vaginal* proceſſes, a large cavity is formed; through the middle of which, from top to bottom, a fiſſure is obſervable, into which part of the ligament that ſecures the articulation of the lower jaw with this bone is fixed. The fore part of the cavity being lined with the ſame cartilage which covers the tubercle before it, receives the *condyle* of the jaw; and in the back-part a ſmall ſhare of the parotid gland, and a cellular fatty ſubſtance, are lodged.—At the inſide of the root of the *ſtyloid appophyſe*, there is a thimble like cavity, where the beginning of the internal jugular vein, or end of the lateral *ſinus* is lodged.—And as the ſinuſes of the two ſides are frequently of unequal ſize; ſo one of theſe cavities is as often larger than the other (*a*).—Round the external *meatus auditorius*, ſeveral ſinuoſities are formed for receiving the car-

(*a*) Hunauld. in Mem. de l'acad. des ſciences, 1730.

tilages and ligaments of the ear, and for their firm adhesion.

The *holes* that commonly appear on the outside of each of these bones, and are proper to each of them, are five.—The *first*, situated between the *zygomatic* and *mastoid* processes, is the orifice of a large funnel-like canal, which leads to the organ of hearing; therefore is called *meatus auditorius externus* *.—The *second* gives passage to the *portia dura* of the seventh pair of nerves, and from its situation between the *mastoid* and *styloid* process, is called *foramen stylo mastoideum* †.—Some way before, and to the inside of the *styloid* processes, is the *third* hole; the canal from which runs first upwards, then forwards, and receives into it the internal *carotid* artery, and the beginning of the intercostal nerve; where this canal is about to make the turn forwards, one, or sometimes two very small holes go off towards the cavity of the ear called *tympanum:* through these *Valsalva* (*a*) affirms the proper artery or arteries of that cavity are sent.—On the anterior edge of this bone, near the former, a *fourth* hole is observable, being the orifice of a canal which runs outwards and backwards, in a horizontal direction, till it terminates in the *tympanum*. This, in the recent subject, is continued forward and inward, from the parts which I mentioned just now as its orifice in the skeleton, to the side of the nostrils; being partly cartilaginous, and partly ligamentous. The whole

* Πόρος της ακοὴς, οπὴ τῶν ὠτῶν, fenestra aurium.
† Aquaeductus Fallopii.
(*a*) De aure humana, cap. 2. § 22. et tab. 7. fig. 1.

whoſe canal is named, *Iter a palato ad aurem*, or *Euſtachian tube*.—On the external ſide of the bony part of this canal, and a top of the chink in the cavity that receives the *condyle* of the lower jaw, is the courſe of the little nerve ſaid commonly to be reflected from the lingual branch of the fifth pair, till it enters the *tympanum*, to run acroſs this cavity, and to have the name of *chorda tympani*.—The *fifth* hole is very uncertain, appearing ſometimes behind the *maſtoid* proceſs; ſometimes it is common to the temporal and occipital bones; and in ſeveral ſculls there is no ſuch hole. The uſe of it, when found, is for the tranſmiſſion of a vein from the external teguments to the lateral *ſinus*: But, in ſome ſubjects, a branch of the occipital artery paſſes through this hole, to ſerve the back part of the *dura mater*; in others, I have ſeen two or three ſuch holes: But they are oftener wanting than found. And we may, once for all, in general remark, That the largeneſs, number, ſituation, and exiſtence of all ſuch holes, that for the moſt part allow only a paſſage for veins from without to the internal receptacles, are very uncertain.

The internal ſurface of the *oſſa temporum* is unequal; the upper circular edge of the ſquamous part having numerous ſmall ridges and furrows for its conjunction with the parietal bones; and the reſt of it is irregularly marked with the convolutions of the middle part of the brain, and with furrows made by the branches of the arteries of the *dura mater*.

From the under part of this internal ſurface, a larger tranſverſe hard craggy protuberance

runs horizontally inwards and forwards, with a ſharp edge above, and two flat ſides, one facing obliquely forwards and outwards, and the other as much backwards and inwards. To the ridge between theſe two ſides, the large lateral proceſs of the *dura mater* is fixed.

Sometimes a ſmall bone, a-kin to the ſeſamoid, is found between the ſmall end of this *petrous* proceſs and the *ſphenoid* bone (*a*).

Towards the back-part of the inſide of the *os temporum*, a large deep *foſſa* is conſpicuous, where the *lateral ſinus* lies; and frequently on the top of the *petrous* ridge, a furrow may be obſerved, where a ſmall ſinus is ſituated.

The internal proper *foramina* of each of theſe bones are, *firſt*, the internal *meatus auditorius* in the poſterior plain ſide of the petrous proceſs. This hole ſoon divides into two; one of which is the beginning of the *aquæduct* of *Fallopius*; the other ends in ſeveral very ſmall canals (*b*) that allow a paſſage to the branches of the *portio mollis* of the ſeventh pair of nerves, into the *veſtibule* and *cochlea*. Through it alſo an artery is ſent, to be diſtributed to the organ of hearing.—The *ſecond* hole, which is on the anterior plain ſide of the craggy proceſs, gives paſſage to a reflected branch of the ſecond branch of the fifth pair of nerves, which joins the *portio dura* of the auditory nerve, while it is in the *aquæduct* (*c*), ſmall

(*a*) Riolan. Comment. de offib. cap. 32.——Winſlow. Expoſition anatomique de corps humain, trait. des os ſecs. § 266.

(*b*) Valſalv. De aure humana, cap. 3. § 11.

(*c*) Valſalv. De aure, cap. 3. § 10.

ſmall branches of blood veſſels accompanying the nerves, or paſſing through ſmaller holes near this one.—The paſſage of the cutaneous vein into the lateral *ſinus*, or of a branch of the occipital artery, is ſeen about the middle of the large *foſſa* for that *ſinus*; and the orifice of the canal of the *carotid* artery is evident at the under part of the point of the *petrous* proceſs.

Beſides theſe proper holes of the temporal bones which appear on their external and internal ſurfaces, there are two others in each ſide that are common to this bone and to the *occipital* and *ſphenoidal* bones; which ſhall be mentioned afterwards in the deſcription of theſe bones.

The upper round part of the ſquamous bones is thin, but equal; while the low petrous part is thick and ſtrong, but irregular and unequal, having the diſtinction of tables and *diploe* confounded, with ſeveral cavities, proceſſes, and bones within its ſubſtance, which are parts of the organ of hearing. That a clear idea may be had of this beautiful, but intricate organ, anatomiſts generally chuſe to demonſtrate all its parts together. I think the method good; and therefore, ſince it would be improper to inſert a compleat treatiſe on the ear here, ſhall omit the deſcription of the parts contained within the *os petroſum* of the ſkeleton.

The temporal bones are joined above to the parietal bones by the ſquamous ſutures, and their poſterior *additamenta*: Before, to the *ſphenoid* bone by the ſuture of that name; to the

cheek-bones by the *zygomatic* ſutures: Behind, to the *occipital* bone, by the *lambdoid* ſuture and its *additamenta*; and they are articulated with the *lower jaw* in the manner which ſhall be deſcribed when this bone is examined.

The purpoſes which theſe two bones ſerve, are eaſily collected, from the general uſe of the *cranium*, and from what has been ſaid in the deſcription of their ſeveral parts.

In an infant, a ſmall fiſſure is to be obſerved between the thin upper part, and the lower craggy part of each of theſe bones; which points out the recent union of theſe parts.—Neither *maſtoid* nor *ſtyloid* proceſſes are yet to be ſeen.—Inſtead of a bony funnel-like external *meatus auditorius*, there is only a ſmooth bony ring, within which the membrane of the drum is faſtened.——At the entry of the *Euſtachian tube*, the ſide of the *tympanum* is not completed.—A little more outward than the internal auditory canal, there is a deep pit, over the upper part of whoſe orifice the interior ſemicircular canal of the ear is ſtretched; and ſome way below this, the poſterior ſemicircular canal alſo appears manifeſtly.

OS OCCIPITIS *, ſo called from its ſituation, is convex on the outſide, and concave internally. Its figure is an irregular ſquare, or rather *rhomboid*; of which the angle above is generally a little rounded; the two lateral angles are more finiſhed, but obtuſe; and the lower one is ſtretched forward in form of a wedge, and thence is called by ſome the *cuneiform*

* Ἰνιον, baſilare, proræ, memoriæ, pixidis, fibroſum, nervoſum, lambde.

form proceſs.—If one would, however, be very nice in obſerving the ſeveral turns which the edges of the *os occipitis* make, five or ſeven ſides, and as many angles of this bone might be deſcribed.

The external ſurface is convex, except at the cuneiform apophyſe, where it is flatted. At the baſe of this triangular proceſs, on each ſide of the great hole, but more advanced forwards than the middle of it, the large oblong protuberances, named the *condyles*, appear, to ſerve for the articulation of this bone with the firſt *vertebra* of the neck. The ſmooth ſurface of each of theſe *condyloid* proceſſes is longeſt from behind forwards, where, by their oblique ſituation, they come much nearer to each other than they are at their back part. Their inner ſides are lower than the external, by which they are prevented from ſliding to either ſide out of the cavities of the firſt *vertebra* (*a*). In ſome ſubjects each of theſe plain ſmooth ſurfaces ſeems to be divided by a ſmall riſing in its middle; and the lower edge of each condyle, next the great *foramen*, is diſcontinued about the middle, by an intervening notch: Whence ſome (*b*) alledge, that each of theſe *apophyſes* is made up of two protuberances.—Round their root a ſmall depreſſion and ſpongy roughneſs is obſervable, where the ligaments for ſurrounding and ſecuring their articulations adhere.—Though the motion of the head is performed on the condyles, yet the center of gravity of that globe does not fall

(*a*) Galen. de uſu part. lib. 12. cap. 7.
(*b*) Diemerbroeck, Anat. lib. 9. cap. 6.

between them, but is a good way further forwards: from which mechaniſm it is evident, that the muſcles which pull the head back, muſt be in a conſtant ſtate of contraction; which is ſtronger than the natural contraction of the proper flexors, elſe the head would always fall forwards, as it does when a man is aſleep, or labours under a palſy, as well as in infants, where the weight of the head far exceeds the proportional ſtrength of theſe muſcles. This ſeeming diſadvantageous ſituation of the condyles is however of good uſe to us, by allowing ſufficient ſpace for the cavities of the mouth and *fauces*, and for lodging a ſufficient number of muſcles, which commonly ſerve for other uſes; but may at pleaſure be directed to act on the head, and then have an advantageous lever to act with, ſo as to be able to ſuſtain a conſiderable weight appended, or other force applied, to pull the head back.

Somewhat more externally than the *condyles* there is a ſmall riſing and ſemilunated hollow in each ſide, which make part of the holes, common to the *occipital* and *petrous* bones.—Immediately behind this, on each ſide, a ſcabrous ridge is extended from the middle of the condyle, towards the root of the *maſtoid* proceſs. Into this ridge the *muſculus lateralis*, commonly aſcribed to *Fallopius*, is inſerted.—About the middle of the external convex ſurface, a large arch runs croſs the bone; from the upper lateral parts of which the *occipital* muſcles have their riſe; to its middle the *trapezii* are attached; and half way between this and the great hole, a leſſer arch is extended.—In the

hollows between the middle of these arches the *complexi* are inserted; and in the depressions more external and further forward than these, the *splenii* are inserted.—Between the middle of the lesser arch and the great hole, the little hollow marks of the *recti minores* appear; and on each side of these the fleshly insertions of the *obliqui superiores* and *recti majores* make depressions.—Through the middle of the two arches a small sharp *spine* is placed, which serves as some sort of partition between the muscles of different sides, or rather is owing to the action of the muscles depressing the bone on each side of it, while this part is free from their compression.—These prints of the muscles on this bone are very strong and plain in some subjects, but are not so distinct in others.—All round the great *foramen* the edges are unequal, for the firmer adhesion of the strong circular ligament which goes thence to the first *vertebra*.—One end of each *lateral* or *moderator* ligament of the head, is fixed to a rough surface at the fore part of each condyle, and the *perpendicular* one is connected to a rough part of the edge of the great hole between the two condyles.—Immediately before the condyles, two little depressions are made in the external surface of the cuneiform process, for the insertion of the *recti anteriores minores* muscles, which are unjustly ascribed to *Cowper:* and still further forward, near the *sphenoid* bone, are two other such depressions, for the reception of the *recti anteriores majores*.—When we consider the size of the prints of muscles on the

occipital bone, before and behind its condyles, and at the ſame time, compare their diſtances from theſe centers of motion of the head, we muſt ſee how much ſtronger the muſcles are which pull the head backwards, than thoſe are which bend it forward; and how much greater force the former acquire by the long lever they act with, than the latter which are inſerted ſo near the condyles. This great force in the extenſor muſcles is altogether neceſſary, that they might not only keep the head from falling forward in an erect poſture, but that they might ſupport it when we bow forward in the moſt neceſſary offices of ſocial life, when the weight of the head comes to act at right angles on the *vertebræ* of the neck, and obtains a long lever to act with.

On the inner ſurface of the *os occipitis* we ſee two ridges; one ſtanding perpendicular, the other running horizontally acroſs the firſt. The upper part of the perpendicular limb of the croſs, to which the *falx* is fixed, is hollowed in the middle, or often on one ſide for the reception of the *ſuperior longitudinal ſinus*, and the lower part of it has the ſmall or third proceſs of the *dura mater* faſtened to it, and is ſometimes hollowed by the *occipital ſinus*. Each ſide of the horizontal limb is made hollow by the lateral ſinuſes incloſed in the tranſverſe proceſs of the *dura mater*; the *foſſa* in the right ſide being generally a continuation of the one made by the longitudinal ſinus in the perpendicular limb, and therefore is larger than the left one (*a*).——Round the middle of the

(*a*) Morgagn. Adverſ. anat. 6. animad. 1.

croſs there are four large depreſſions ſeparated by its limbs; the two upper ones being formed by the back part of the brain, and the two lower ones by the *cerebellum*.——Farther forward than the laſt mentioned depreſſions, is the lower part of the *foſſa* for the lateral *ſinus* on each ſide.——The inner ſurface of the cuneiform apophyſe is made concave for the reception of the *medulla oblongata*, and of the *baſilar* artery.—A furrow is made on each ſide, near the edges of this proceſs, by a *ſinus* of the *dura mater*, which empties itſelf into the lateral *ſinus* (*a*).

The holes of this bone are commonly five proper, and two common to it and to the *temporal* bones.—The firſt of the proper holes, called *foramen magnum* * from its ſize, is immediately behind the wedge-like proceſs, and allows a paſſage to the *medulla oblongata*, *nervi acceſſorii*, to the vertebral arteries, and ſometimes to the vertebral veins.——At each ſide of this great hole, near its fore-part, and immediately above the condyles, we always find a hole, ſometimes two, which ſoon unite again into one that opens externally; thro' theſe the ninth pair of nerves go out of the ſcull.—The fourth and fifth holes pierce from behind the *condyle* of each ſide into the *foſſæ* of the lateral *ſinuſes*; they ſerve for the paſſage of the cervical veins to theſe *ſinuſes*. Often one of theſe holes is wanting, ſometimes both, when the veins paſs thro' the great *foramen*.—Beſides theſe five, we frequently meet with other holes near the edges of this bone, for the

 tranſmiſſion

(*a*) Albin. de offib. § 65.

* Rachitidis, Medullæ ſpinalis.

tranſmiſſion of veins; but their number and diameter are very uncertain. The two common *foramina* are the large irregular holes, one in each ſide, between the ſides of the *cuneiform* proceſs, and the edges of the *petrous* bones. In a recent ſubject, a ſtrong membrane runs croſs from one ſide to the other of each of theſe holes; in ſome heads I have ſeen this membrane oſſified, or a bony partition dividing each hole; and, in the greater number of adult ſculls, there is a ſmall ſharp-pointed proceſs ſtands out from the *os petroſum*, and a more obtuſe riſing in the occipital bone, between which the partition is ſtretched. Behind this partition, where the largeſt ſpace is left, the *lateral ſinus* has its paſſage; and before it the eighth pair of nerves and *acceſſorius* make their exit out of the ſcull; and ſome authors ſay, an artery paſſes through this hole, to the *dura mater*.

The *occipital* bone is among the thickeſt of the *cranium* though unequally ſo; for it is ſtronger above, where it has no other defence than the common teguments, than it is below, where being preſſed by the lobes of the brain and *cerebellum* on one ſide, and by the action of the muſcles on the other, it is ſo very thin, as to be diaphanous in many ſculls: But then theſe muſcles ward off injuries, and the ridges and ſpines, which are frequent here, make it ſufficiently ſtrong to reſiſt ordinary forces. The tables and *diploe* are tolerably diſtinct in this bone, except where it is ſo thin as to become diaphanous.

The

The occipital bone is joined above to the *offa parietalia* and *triquetra* when preſent, by the *lambdoid* ſuture;——laterally to the temporal bones, by the *additamenta* of the *lambdoid* ſuture;——below to the *ſphenoid* bone, by the end of its cuneiform proceſs, in the ſame way that epiphyſes and their bones are joined: For in children a ligamentous cartilage is interpoſed between the occipital and ſphenoid bones, which gradually turns thinner, as each of the bones advances, till their fibres at laſt run into each other; and, about ſixteen or eighteen years of age, the union of theſe two bones becomes ſo intimate, that a ſeparation cannot be made without violence.——The *os occipitis* is joined by a double articulation to the firſt *vertebra* of the neck, each condyle being received into a ſuperior oblique proceſs of that *vertebra*. What motion is allowed here, we ſhall conſider afterwards, where the *vertebræ* are deſcribed.

The uſes of this bone appear from the preceding deſcription, and therefore need not be repeated.

An infant born at the full time, has this bone divided, by unoſſified cartilages, into four parts.——The firſt of theſe is larger than the other three, is of a triangular ſhape, and conſtitutes all the part of the bone above the great *foramen*. Generally fiſſures appear in the upper part and ſides of this triangular bone, when all the cartilage is ſeparated by maceration; and ſometimes little diſtinct bones are ſeen towards the edges of it.—The ſecond and third pieces of this bone are exactly alike, and

ſituated on each ſide of the great *foramen*; from which very near the whole condyles are produced; and they are extended forwards almoſt to the fore-part of the hole for the ninth pair of nerves.—The fourth piece is the cuneiform proceſs, which forms a ſmall ſhare of the great hole, and of theſe for the ninth pair of nerves, and of the condyles: betwixt it and the *ſphenoid* bone, a cartilage is interpoſed.

Of the eight bones which belong to the *cranium*, there are only two which are not yet deſcribed, *viz.* the *ethmoid* and *ſphenoid*. Theſe we already mentioned, in complaiſance to the generality of writers on this ſubject, as bones common to the *cranium* and face, becauſe they enter into the compoſition of both: but the ſame reaſon might equally be uſed for calling the frontal bone a common one too. I ſhall, however, paſs any idle diſpute about the propriety of ranging them, and proceed to examine the ſtructure of the bones themſelves.

OS ETHMOIDES *, or the ſieve-like bone, has got its name from the great number of ſmall holes with which that part of it firſt taken notice of is pierced. When this bone is entire, the figure of it is not eaſily deſcribed; but, by a detail of its ſeveral parts, ſome idea may be afforded of the whole; and therefore I ſhall diſtinguiſh it into the *cribriform lamella* with its proceſs, the *naſal lamella*, *cellulæ*, and *oſſa ſpongioſa*.

The thin horizontal *lamella*, is all (except its back part) pierced obliquely by a great number of ſmall holes, through which the fila-

* Cribriforme, σποχγοειδὲς, ſpongiforme, criſtatum.

ments of the olfactory nerves pafs. In a recent fubject, thefe holes are fo clofely lined by the *dura mater*, that they are much lefs conſpicuous than in the *ſkeleton*.——From the middle of the internal ſide of this plate, a thick proceſs rifes upwards, and, being higheſt at the fore-part, gradually becomes lower, as it is extended backwards. From ſome reſemblance which this proceſs was imagined to have to a cock's comb, it has been called *criſta galli* *, The *falx* is connected to its ridge, and the unperforated part of the cribriform plate.—— When the *criſta* is broke, its baſe is ſometimes found to be hollow, with its cavity opening into the noſe (*a*).——Immediately before the higheſt part of this proceſs, is the blind hole of the *frontal* bone, which, as was formerly remarked, is often in a good meaſure formed by a notch in the fore-part of the root of the *criſta*.

From the middle of the outer ſurface of the *cribriform lamella*, a thin ſolid plate is extended downwards and forwards, having the ſame common baſe with the *criſta galli*. Generally it is not exactly perpendicular, but is inclined to one ſide or other, and therefore divides the cavity of the noſe unequally. Its inclination to one ſide, and flexure in the middle, is ſometimes ſo great, that it fills up a large ſhare of one of the noſtrils, and has been miſtaken for a *polypus* there.—It is thin at its riſe, and rather ſtill thinner in its middle; yet afterwards, towards its lower edge, it becomes thicker,

* Verruca praedura, ſeptum oſſis ſpongioſi.

(*a*) Palfyn. Anat. chir. tr. 4. chap. 15.

that its conjunction with the bones and middle cartilage of the nose might be firmer.

At a little distance from each side of this external process, a cellular and spongy bony substance depends from the cribriform plate. The number and figure of the cells in this irregular process of each side, are very uncertain, and not to be represented in words; only the cells open into each other, and into the cavity of the nose: The uppermost, which are below the aperture of the frontal *sinuses*, are formed like funnels.——The outer surface of these cells is smooth and plain, where this bone assists in composing the orbit; at which place, on each side, it has got the name of *os planum*; on the upper edge of which, a small notch or two may sometimes be observed, which go to the formation of the internal orbital holes; as was remarked in the description of the frontal bone.

Below the cells of each side, a thin plate is extended inwards, and then bending down, it becomes thick and of a spongy texture.——— This spongy part is triangular, with a streight upper edge placed horizontally, an anterior one slanting from above, downwards and forwards, and with a pendulous convex one below.—The upper and lower edges terminate in a sharp point behind—The side of this pendulous spongy part next to the *septum narium* is convex, and its external side is concave.—These two processes of the *ethmoid* bone have got the name of *ossa spongiosa* or *turbinata superiora*, from their substance, figure, and situation.

All

All the prominences, cavities and *meanders* of this *ethmoid* bone, are covered with a continuation of the membrane of the noſtrils, in a recent ſubject.——Its horizontal cribriform plate is lodged between the orbitar proceſſes of the *frontal* bone, to which it is joined by the *ethmoid* ſuture, except at the back-part where it is connected with the *cuneiform* bone, by a ſuture common to both theſe bones, though it is generally eſteemed part of the *ſphenoidal*.——Where the *oſſa plana* are contiguous to the frontal bone within the orbit, their conjunction is reckoned part of the tranſverſe ſuture.——Farther forward than the *oſſa plana*, the cells are covered by the *oſſa unguis*, which are not only contiguous to theſe cells, but cannot be ſeparated from them, without breaking the bony ſubſtance; and therefore, in juſtice, thoſe bones ought to be demonſtrated as part of the *ethmoid* bone.——Below the *oſſa unguis* and *plana*, theſe cells and *oſſa ſpongioſa* are overlopped by the *maxillary* bones.—The cellular part of each *palate* bone is contiguous to each *os planum* and cells backwards.—The lower edge of the naſal perpendicular plate is received into the furrow of the *vomer*.——Its poſterior edge is joined to the fore part of the *proceſſus azygos* of the *ſphenoid* bone.——Its upper edge joins the *naſal* proceſs of the *frontal* and *naſal* bones, and its anterior one is connected to the middle cartilage of the noſe.

From all which, the uſes of this bone are evident, *viz.* to ſuſtain the anterior lobes of the brain; to give paſſage to the olfactory nerves, and attachment to the *falx*; to enlarge the

organ of ſmelling, by allowing the membrane of the noſe a great extent; to ſtraiten the paſſage of the air through the noſe, by leaving only a narrow winding canal, on the ſenſible membranous ſides of which the ſubſtances conveyed along with the air muſt ſtrike; to form part of the orbit of the eyes and *ſeptum narium*; while all its parts are ſo light as not to be in hazard of ſeparating by their weight; and they are ſo thin, as to form a large ſurface, without occupying much ſpace. This brittle ſubſtance, however, is ſufficiently protected from external injuries by the firm bones which cover it.

If this bone is ſeized on by any corroding matter, we may eaſily conceive what deſtruction may enſue. Hence it is, that an *ozaena* is difficult to cure; and that, in violent *ſcurvies* or in the *lues venerea*, the fabric of the noſe, the eyes, and life itſelf are in danger.—The ſituation of the naſal plate may ſhew us, how dangerous a fracture of the bones of the noſe may be, when made by a force applied to their middle fore-part, of a perſon in whom this naſal plate is perpendicular.

The *ethmoid* bone of ripe children is divided into two, by a perpendicular cartilage, which, when oſſified, is the *criſta galli*, and naſal plate: but its other parts are oſſified and complete.

OS SPHENOIDES *, or wedge-like bone, ſo called becauſe of its ſituation in the

* Cuneiforme, πολυμόρφον, multiforme, paxillum, cribratum palati, colatorii, cavilla, baſilare.

middle of the bones of the *cranium* and face, is of ſuch an irregular figure, that I know not any thing to which it may be likened, unleſs, perhaps, it bear ſome faint reſemblance to a bat with its wings extended.

When we view the external ſurface of the *os ſphenoides*, two or three remarkable proceſſes from each ſide of it may be obſerved, which are all of them again ſubdivided.—The firſt pair is the two large lateral proceſſes or wings; the upper part of each of which is called the *temporal proceſs*, becauſe they join with the temporal bones in forming the temples, and the ſeat for ſome ſhare of the *crotaphite* muſcles. That part of the wings which jutts out towards the inſide, ſomewhat lower than the temporal *apophyſes*, and is ſmooth and hollowed, where it makes up part of the orbit, is thence named *orbitar proceſſes*. Behind the edge, ſeparating theſe two proceſſes, there is often a ſmall groove, made by a branch of the ſuperior maxillary nerve, in its paſſage to the temporal muſcle. The loweſt and back part of each wing, which runs out ſharp to meet the *oſſa petroſa*, has been ſtyled the *ſpinous* proceſs: From near the point of which a ſharp pointed proceſs is frequently produced downwards, which ſome call *ſtyliform*, that affords origin to the *ptery ſtaphylinus externus* muſcle. From this ſtyloid proceſs a very ſmall groove is extended along the edge of the bone to the hollow at the root of the internal plate of the following proceſs, which forms

forms part of the *Euſtachian* tube (*a*).—The ſecond pair of external proceſſes of the *cuneiform* bone is the two which ſtand out almoſt perpendicular to the baſe of the ſcull. Each of them has two plates, and a middle *foſſa* facing backwards, and ſhould, to carry on our compariſon, be likened to the bat's legs, but are commonly ſaid to reſemble the wings of that creature; and therefore are named *pterygoid* or *aliform* * proceſſes. The external plates are broadeſt, and the internal are longeſt. From each ſide of the external plates the *pterygoid* muſcles take their riſe. At the root of each internal plate, a ſmall hollow may be remarked, where the *muſculus ptery-ſtaphylinus internus*, or *circumflexus palati* riſes, and ſome ſhare of the cartilaginous end of the *Euſtachian* tube reſts; and, at the lower end of the ſame plate, is a hook-like riſing or proceſs, round which the tendon of the laſt named muſcle plays, as on a pulley. From the edge of the external plates ſome ſmall ſharp ſpikes ſtand out; but their number and bulk are uncertain.—To theſe another pair may be added, to wit, the little triangular thin proceſs, which comes from each ſide of the body of the *ſphenoid* bone, where the *pterygoid* proceſſes are riſing from it, and are extended over the lower part of the aperture of the *ſinus* as far as to join the *ethmoid* bone, while their body

 hangs

(*a*) Winſlow, Expoſition anatomique du corps humain, traite des os ſecs. § 233.

* Naviculares.

hangs down into the *nares* (*a*).—Beſides theſe pairs of proceſſes, there is a ſharp ridge which ſtands out from the middle of its baſe: Becauſe it wants a fellow, it may be called *proceſſus azygos*. The lower part of this proceſs, where it is received into the *vomer*, is thick, and often not quite perpendicular, but inclining more to one ſide than the other. The fore-part of this proceſs, where it joins the naſal plate of the *os ethmoides*, is thin and ſtreight. Theſe two parts have been deſcribed as two diſtinct proceſſes by ſome.

The depreſſion, ſinuoſities, and *foſſæ*, on the external ſurface of the *ſphenoid* bone, may be reckoned up to a great number, *viz.* two on the temporal *apophyſes* where the *crotaphite* muſcles lodge.—Two on the *orbitar* proceſſes, to make way for the globes of the eyes.——Two between the *temporal* and *ſpinous* proceſſes, for receiving the temporal bones.—Two between the plates of the *pterygoid* proceſſes, where the *muſculi pterygoidei interni* and *ptery ſtaphylini interni* are placed.———Two between the *pterygoid* and *orbitar* proceſſes, for forming the holes common to this and to the *cheek* and *maxillary* bones. Two on the lower ends of the *aliform* proceſſes, which the *palate* bones enter into.——Two at the roots of the *temporal* and *pterygoid* proceſſes, where the largeſt ſhare of the external *pterygoid* muſcles have their riſe.—Two at the ſides of the *proceſſus azygos*, for forming part of the noſe, *&c.*

What I deſcribed under the name of *tempo-*

(*a*) Albin. Tab. oſſ. 5. fig. 2. 6. A. A.—Bertin. Mem. de l'acad. des ſciences 1744.—Sue. planche viii. fig. 2, 3, 4, 5, 6.

ral and *ſpinous proceſſes* on the outſide of the ſcull, are likewiſe ſeen on its inſide, where they are concave, for receiving part of the brain; and commonly three *apophyſes* on the internal ſurface of the *ſphenoid* bone are only mentioned.—Two riſing broad from the fore-part of its body, become ſmaller as they are extended obliquely backwards.—The third ſtanding on a long tranſverſe baſe, near the back-part of the body of this bone, riſes nearly erect, and of an equal breadth, terminating often in a little knob on each ſide. The three are called *clinoid*, from ſome reſemblance which they were thought to have to the ſupporters of a bed. Sometimes one or both the anterior *clinoid* proceſſes are joined to the ſides of the poſterior one, or the body of the bone itſelf.—From the roots of the anterior *clinoid* proceſſes the bone is extended on each ſide outwards and forwards, till it ends in a ſharp point, which may have the name of the *tranſverſe ſpinous* proceſſes.—Between, but a little farther back than the two anterior *clinoid* proceſſes, we ſee a protuberance conſiderably ſmaller than the poſterior *clinoid* proceſs, but of its ſhape.—Another proceſs from between the tranſverſe proceſſes, often forces itſelf forwards into the *os ethmoides*.

Within the ſcull, there are two ſinuoſities in the internal part of each wing of the *ſphenoid* bone, for receiving the middle part of the brain.——One between the tranſverſe ſpinous proceſſes, for lodging the part of the brain where the *crura medullæ oblongatæ* are.—Immediately before the third or middle *clinoid*

proceſs, a ſingle pit generally may be remarked, from which a *foſſa* goes out on each ſide to the holes through which the optic nerves paſs. The pit is formed by the conjoined optic nerves; and in the *foſſæ* theſe nerves are lodged, as they run divided within the ſcull.—Between the third protuberance and the poſterior *clinoid* proceſs, the larger pit for the *glandula pituitaria* may be remarked. This cavity, becauſe of its reſemblance to a *Turkiſh* ſaddle, is always deſcribed under the name of *ſella Turcica*, or *ephippium*.——On the ſides of the poſterior *clinoid* proceſs a *foſſa* may be remarked, that ſtretches upwards, then is continued forwards along the ſides of the *ſella Turcica*, near to the anterior *clinoid* proceſſes, where a pit on each ſide is made. Theſe *foſſæ* point out the courſe of the two internal *carotid* arteries, after they have entered the ſcull.—Beſides all theſe, ſeveral other *foſſæ* may be obſerved, leading to the ſeveral holes, and imprinted by the nerves and blood-veſſels.

The holes on each ſide of the *os ſphenoides* are ſix proper, and three common.——The *firſt* is the round one immediately below the anterior *clinoid* proceſſes, for the paſſage of the optic nerve, and of the branch of the internal *carotid* artery that is ſent to the eye.——The *ſecond* is the *foramen lacerum*, or large ſlit between the tranſverſe ſpinous and orbitar proceſſes: The interior end of which ſlit is large: and, as it is extended outwards, it becomes narrower. The outer end of it is formed in the *os frontis*; and therefore this might be reckoned among the common *foramina*.

Through it the third, fourth, the firſt branch of the fifth, and the greater ſhare of the ſixth pair of nerves, and an artery from the internal carotid, go into the orbit. Sometimes a ſmall branch of the external carotid enters near its end, to be diſtributed to the *dura mater* (*a*), and a vein, ſome call it the *venous duct*, or, *Nuck's aquæduct*, returns through it to the cavernous *ſinus*.——The *third* hole, ſituated a little below the one juſt now deſcribed, is called *rotundum*, from its ſhape. It allows paſſage to the ſecond branch of the fifth pair of nerves, or ſuperior maxillary nerve, into the bottom of the orbit.——The *fourth* is the *foramen ovale*, about half an inch behind the round hole. Through it the third branch of the fifth pair, or inferior maxillary nerve, goes out; and ſometimes a vein from the *dura mater* paſſes out here (*b*).——Very near the point of the ſpinous proceſs is the *fifth* hole of this bone: It is ſmall and round, for a paſſage to the largeſt artery of the *dura mater*, which often is accompanied with a vein.——The *ſixth* proper hole (*c*) cannot be well ſeen, till the cuneiform bone is ſeparated from all the other bones of the *cranium*; for one end of it is hid by a ſmall protuberance of the internal plate of the *pterygoid* proceſs, and by the point of the *proceſſus petroſus*

(*a*) Winſlow. Expoſition anatomique du corps humain, traité des arteries, § 60. et de la tete, § 26.

(*b*) Ingraſſ. Commentar. in Galen. de oſſib. lib. 1. comment. 8.

(*c*) Veſal. Anat. lib. 1. cap. 12.——Euſtach. tab. 46. fig. 13 & 16.—Vidus Vidius, Anat. lib. 2. cap. 2. explicat. tab. 5, & tab. 5. fig. 8, 9, 10, lit. O.

petroſus of the *temporal* bone. Its canal is extended above the inner plate of the *pterygoid* proceſs; and where it opens into the cavity of the noſe, it is concealed by the thin laminous part of the *palate* bone. Through it a conſiderable branch of the ſecond branch of the *fifth* pair of nerves is reflected.——Often in the middle of the *ſella Turcica* a ſmall hole or two pierce as far as the cellular ſubſtance of the bone: and ſometimes at the ſides of this *ſella*, one or more ſmall holes penetrate into the *ſphenoidal ſinuſes*. Theſe obſervations afforded ſome anatomiſts (*a*) an argument of weight in their days in defence of *Galen* (*b*), who aſſerted the deſcent of the *pituita* that way into the *ſinuſes* below.

The *firſt* of the common holes is that unequal fiſſure at the ſide of the *ſella Turcica*, between the extreme point of the *os petroſum* and the *ſpinous* proceſs of the cuneiform bone. This hole only appears after the bones are boiled; for in a recent ſubject its back-part is covered by a thin bony plate that lies over the internal carotid artery, and further forward it is filled with a cartilaginous ligament, under which the cartilaginous part of the *Euſtachian tube* is placed: It was by this paſſage that the ancients believed the *ſlimy matter* was conveyed from the emunctory of the brain, the *glandula pituitaria*, to the *fauces*.—The *ſecond* common hole is the large diſcontinuation of the external ſide of the orbit, left between the orbitar

(*a*) Jac. Sylv. Calumniæ ſecundæ amolitio.——Laurent. Hiſt. anat. lib. 2. quæſt. 11.

(*b*) Galen, De uſu part. lib. 9. cap. 1.

proceſſes of the cuneiform bone, the *os maxillare*, *malæ*, and *palati*. In this large hole the fat for lubricating the globe of the eye and temporal muſcles is lodged, and branches of the ſuperior maxillary nerve, with ſmall arteries from the carotid and veins paſs.——The *third* hole is formed between the baſe of this bone and the root of the orbitar proceſs of the palate-bone of each ſide. Through this a branch of the external carotid artery, and of the ſecond branch of the fifth pair of nerves, are allowed a paſſage to the noſtrils, and a returning vein accompanies them. Sometimes, however, this hole is proper to the palate bone, being entirely formed out of its ſubſtance.

Under the *ſella Turcica*, and ſome way farther forward, but within the ſubſtance of the *ſphenoid* bone, are two *ſinuſes*, ſeparated by a bony plate. Each of them is lined with a membrane, and opens into the upper and back-part of each noſtril by a round hole, which is at their upper fore-part. This hole is not formed only by the *os ſphenoides*, which has an aperture near as large as any tranſverſe ſection of the *ſinus*, but alſo by the *palate* bones which are applied to the fore-part of theſe *ſinuſes*, and cloſe them up, that hole only excepted, which was already mentioned. Frequently the two *ſinuſes* are of unequal dimenſions, and ſometimes there is only one large cavity, with an opening into one noſtril. Theſe cavities are likewiſe ſaid (*a*) to be extended ſometimes as far back as the great *foramen* of the occipital bone. In other ſub-

j. &s

(*a*) Albin. de oſſib. § 39.

jects they are not to be found, when the bone is compoſed of large cells (*a*). Some (*b*) mention a cavity within the partition of the *ſinuſes*; but it is ſmall.—The *ſphenoidal ſinuſes* ſerve the ſame uſes as the frontal do.

As this bone is extremely ragged and unequal, ſo its ſubſtance is of very different thickneſs, being in ſome places diaphanous; in others it is of a middle thickneſs, and its middle back part ſurpaſſes the greateſt ſhare of the *cranium* in thickneſs.

The *os ſphenoides* is joined by its wings, to the *parietal* bones above, to the *os frontis* and *oſſa malarum* before, to the *temporal* bones behind;——By the fore part of its body and ſpinous proceſſes, to the *frontal* and *ethmoid* bones;—by its back-part, behind the two *ſinuſes*, to the *occipital*, where it looks like a bone with the *epiphyſes* taken off, and, as was formerly obſerved in the deſcription of the occipital bone, it cannot be ſeparated without violence in adults;——to the *palate* bones, by the ends of the *pterygoid* proceſſes, and ſtill more by the fore-part of the internal plates of the *pterygoid* proceſſes, and of the *ſinuſes*;—to the *maxillary* bones, by the fore part of the external *pterygoid* plates;—to the *vomer* and naſal plate of the *os ethmoides*, by the *proceſſus azygos*. All theſe conjunctions, except the laſt, which is a *ſchindyleſis*, are ſaid to be by the future proper to this bone, though it is at firſt ſight evident, that ſeveral other futures,

(*a*) Veſal. lib. 1. cap. 6.
(*b*) Id. ibid.

as the *transverse, ethmoidal, &c.* are confounded with it.

We see now how this bone is joined to all the bones of the *cranium*, and to most of the upper jaw; and therefore obtained the name of the *wedge like bone*.

The uses are so blended with the description, as to leave nothing new to be added concerning them.

The *sphenoidal* bone is almost compleat in a *fœtus* of nine months; only the great *alæ* separate after maceration from the body of the bone.—The *processus azygos* is very large and hollow;—the thin triangular processes are not ossified;——the internal surface of the body is unequal and porous;———the *sinuses* do not appear.

Whoever is acquainted with each bone of the *cranium*, can, without difficulty, examine them as they stand united, so as to know the shapes, sizes, distances, *&c.* of their several parts, and the forms, capacities, *&c.* of the cavities formed by them, which is of great use towards understanding the anatomy of the parts contiguous to, contained within, or connected to them. Such a review is necessary, after considering each class of bones. Thus the orbits, nostrils, mouth, face, head, spine, *thorax pelvis*, trunk, extremities, and skeleton, ought likewise to be examined.

The *FACE* is the irregular pile of bones, composing the fore and under part of the head, which is divided, by authors, into the upper and lower *maxillæ* or jaws.

The

The *ſuperior maxilla** is the common deſignation given to the upper immoveable ſhare of the face; though, if we would follow *Celſus (a)*, we ſhould apply the word *maxilla* to the lower jaw only, and the name *mala* to the upper jaw. In complaiſance to prevailing cuſtom, I ſhall, however, uſe the terms as now commonly employed. The ſhape of the ſuperior jaw cannot eaſily be expreſſed; nor is it neceſſary, provided the ſhape and ſituation of all the bones which compoſe it are deſcribed. It is bounded above by the tranſverſe future, behind by the fore-part of the *ſphenoid* bone, and below by the mouth.

The upper jaw conſiſts of ſix bones on each ſide, of a thirteenth bone which has no fellow, placed in the middle, and of ſixteen teeth. The thirteen bones are, two *oſſa naſi*, two *oſſa unguis*, two *oſſa malarum*, two *oſſa maxillaria*, two *oſſa palati*, two *oſſa ſpongioſa inferiora*, and the *vomer*.

The *oſſa naſi* are placed at the upper part of the noſe;——the *oſſa unguis* are at the internal *canthi* of the orbits;—*oſſa malarum* form the prominence of the cheeks;—*oſſa maxillaria* from the ſide of the noſe, with the whole lower and fore part of the upper jaw, and the greateſt ſhare of the roof of the mouth;—*oſſa palati* are ſituated at the back-part of the palate, noſtrils, and orbit;—*oſſa ſpongioſa* are ſeen in the lower part of the *nares*;—and the *vomer* helps to ſeparate theſe two cavities.

* Σιαγων, γενος, mandibula.
(a) Lib. 8. cap. 1.

The bones of the *upper jaw* are joined to the bones of the ſcull by the *ſchindyleſis* and ſutures already deſcribed as common to the *cranium* and *face*, and they are connected to each other by *gomphoſis* and fifteen ſutures.

The *gomphoſis* only is where the teeth are fixed in their ſockets, and the *ſchindyleſis* is only where the edges of the *vomer* are joined to other bones.

The ſutures are generally diſtinguiſhed by numbers, which have been differently applied; and therefore I join thoſe (*a*) who prefer the giving names to each, which may be eaſily contrived from their ſituation, or from the bones which they connect.

The firſt is the *anterior naſal* *, which is ſtreight, and placed longitudinally in the middle part of the noſe.

The ſecond and third are the *lateral naſal* †, which are at each ſide of the noſe, and almoſt parallel to the firſt ſuture.

Each of the two *lacrymal* is almoſt ſemicircular, and is placed round the *lacrymal* groove.

The ſixth and ſeventh are the *internal orbitar*: each of which is extended obliquely from the middle of the lower ſide of an orbit to the edge of its baſe.

The two *external orbitars* are continued, each from the end of the internal orbitar, to the under and fore-part of the cheek.

(*a*) Vander Linden. Medicin. phyſiolog. cap. 13. art 2. § 10.—Rolfinc. Anat. lib. 2. cap. 25.—Schenk. Schol. part. § ult. part 2. cap. 5.

* Naſalis recta.

† Naſalis obliqua.

The tenth is the *myſtachial*, which reaches only from the lower part of the *ſeptum narium* to between the two middle *dentes inciſores*.

The *longitudinal palate* * ſuture ſtretches from the middle of the foremoſt teeth through the middle of all the palate.

The *tranſverſe palate* one † runs acroſs the palate, nearer the back than the fore part of it.

Each of the two *palato maxillary* is at the back-part of the ſide of each noſtril.

The fifteenth is the *ſpinous*, which is in the middle of the lower part of the noſtrils. This may perhaps be rather thought a double *ſchindeliſis*.

The connection of the *oſſa ſpongioſa* to the ſide of each noſtril, is ſo much by a membrane in young ſubjects, by a ſort of hook and afterwards by concretion or union of ſubſtance in adults, that I did not know well how to rank it: But if any chuſes to call it a ſuture, the addition of two *tranſverſe naſal* ſutures may be made to thoſe above named.

Theſe ſutures of the face (formerly called *harmoniæ*) have not ſuch conſpicuous indentations as thoſe of the ſcull have; the bones here not having ſubſtance enough for forming large indentations, and there being leſs neceſſity for ſecurity againſt external injuries, or any internal protruding force, than in the *cranium*.——Theſe ſutures often diſappear in old people, by the bones running into each other; which can do little prejudice, becauſe the principal

I

* Laquearis, palataria recta.
† Arcuata, palatina poſtica.

cipal uſe of the bones being ſo numerous here, is to allow them to be extended into a proper form.

It is evident, from the manner of the conjunction of theſe bones, that they can have no motion, except in common with the *cranium*.

The purpoſes which this pile of bones ſerves, will be ſhewn in the deſcription which I am to give of each of them.

OSSA NASI, ſo named from their ſituation at the root of the noſe, are each of an irregular oblong ſquare figure, being broadeſt at their lower end, narroweſt a little higher than their middle, and becoming ſomewhat larger at the top, where they are ragged and thickeſt, and have a curvature forwards, that their connection with the *frontal* bone might be ſtronger.——Theſe bones are convex externally, and thereby better reſiſt any violence from without; and they are concave internally, for enlarging the cavity of the noſe.

The lower edge of theſe bones is unequal, and is ſtretched outwards and backwards, to join the cartilages of the noſtrils.—Their anterior ſide is thick, eſpecially above, and unequal, that their conjunction to each other might be ſtronger; and a ſmall riſing may be remarked on their inner edge, where they are ſuſtained by the *ſeptum narium*.—Their poſterior ſide, at its upper half, has externally a depreſſion, where it is overlopped ſome way by the *maxillary* bones, while its lower half covers theſe bones: By which contrivance, they do not yield eaſily to preſſure applied to their fore-part or ſides.

A ſmall

A ſmall hole is frequently to be obſerved on their external ſurface, into which two, three, or four holes, which appear internally, terminate for the tranſmiſſion of ſmall veins; ſometimes the holes go no further than the *cancelli* of the bones.

The *naſal bones* are firm and ſolid, with very few *cells* or *cancelli* in them; the thin ſubſtance of which they conſiſt not requiring much marrow.

They are joined above to the *frontal* bone, by the middle of the *tranſverſe* ſuture;—behind, to the *maxillary* bones, by the *lateral naſal* ſutures;—Below, to the cartilages of the noſe;—Before, to one another, by the *anterior naſal* ſuture;——internally, to the *ſeptum narium*.

Theſe bones ſerve to cover and defend the root of the noſe.

In an infant the *naſal bones* are proportionally ſhorter, and leſs thick at their upper-part, than in an adult, but are otherwiſe compleat.

OSSA UNGUIS, or *LACRIMALIA*, are ſo named, becauſe their figure and magnitude are ſomething near to thoſe of a nail of one's finger, and becauſe the tears paſs upon them into the noſe.

Their external ſurface is compoſed of two ſmooth concavities and a middle ridge.——The depreſſion behind forms a ſmall ſhare of the orbit for the eye-ball to move on, and the one before is a deep perpendicular canal, or *foſſa*, larger above than below, containing part of the lacrymal *ſac* and *duct*. This is the part that ought to be pierced in the great operation

tion

tion for the *fiſtula lacrymalis*.——This *foſſa* of the bone is cribriform, or has a great number of ſmall holes through it, that the filaments from the membrane which lines it, inſinuating themſelves into theſe holes, might prevent a ſeparation of the membrane, and ſecure the bone in its natural ſituation.——The ridge between theſe two cavities of the *os unguis*, is the proper boundary of the orbit at its internal *canthus*: and beyond which ſurgeons ſhould not proceed backwards in performing operations here.—The internal or poſterior ſurface of this bone conſiſts of a furrow in the middle of two convexities.

The ſubſtance of the *os unguis* is as thin as paper, and very brittle; which is the reaſon that theſe bones are often wanting in ſkeletons, and need little force to pierce them in living ſubjects.

Each of theſe bones is joined, above, to the *frontal* bone, by part of the *tranſverſe* ſuture; ——behind, to the *os planum* of the *ethmoid* bone by the ſame ſuture;—before and below, to the *maxillary* bone, by the *lacrymal* ſuture. internally, the *oſſa unguis* cover ſome of the *ſinus ethmoidales*; nay, are really continuous with the bony *lamellæ* which make up the ſides of theſe cells; ſo that they are as much part of the *ethmoid* bone as the *oſſa plana*.

The unguiform bones compoſe the anterior internal parts of the orbits, lodge a ſhare of the lacrymal ſac and duct, and cover the *ethmoid* cells.——Their ſituation and tender ſubſtance make a raſh operator in danger of deſtroying a conſiderable ſhare of the organ of ſmelling,

ſwelling, when he is performing the operation of the *fiſtula lacrymalis*; but when theſe bones are hurt, they caſt off without much difficulty, and conſequently the wound is ſoon cured, unleſs the patient labours under a general *cacoethes*, or there is a prediſpoſition in the bones to *caries*; in which caſe, a large train of bad ſymptoms follow, or, at beſt, the cure proves tedious.

Theſe bones are fully formed in a new born child.

OSSA MALARUM * was the name given by *Celſus*, as was already remarked, to all the upper jaw; but is now appropriated to the prominent ſquare bones which form the cheek on each ſide.—Before, their ſurface is convex and ſmooth; backward, it is unequal and concave, for lodging part of the *crotaphyte* muſcles.

The four angles of each of theſe bones have been reckoned proceſſes by ſome.—The one at the external *canthus* of the orbit, called the *ſuperior orbitar* proceſs, is the longeſt and thickeſt.—The ſecond terminates near the middle of the lower edge of the orbit in a ſharp point, and is named the *inferior orbitar* proceſs.—— The third, placed near the lower part of the cheek, and thence called *maxillary*, is the ſhorteſt, and neareſt to a right angle.——The fourth, which is called *zygomatic*, becauſe it is extended backwards to the *zygoma* of the temporal bone, ends in a point, and has one ſide ſtreight, and the other ſloping.—Between the

* Jugalia vel zygomatica, hypopia, ſubocularia.

two orbitar angles there is a concave arch, which makes about a third of the external circumference of the orbit, from which a fifth proceſs is extended backwards within the orbit, to form near one third of that cavity; and hence it may be called the *internal orbitar* proceſs.—From the lower edge of each of the *oſſa malarum*, which is between the maxillary and zygomatic proceſſes, the *maſſeter* muſcle take its origin; and from the exterior part of the *zygomatic* proceſs, the *muſculus diſtortor oris* riſes; in both which places the ſurface of the bone is rough.

On the external ſurface of each cheek-bone, one or more ſmall holes are commonly found, for the tranſmiſſion of ſmall nerves or blood-veſſels from, and ſometimes into the orbit.—On the internal ſurface are the holes for the paſſage of the nutritious veſſels of theſe bones.——A notch on the outſide of the *internal orbitar* proceſs of each of theſe bones aſſiſts to form the great ſlit common to this bone and to the ſphenoid, maxillary, and palate bones.

The ſubſtance of theſe bones is, in proportion to their bulk, thick, hard, and ſolid, with ſome *cancelli*.

Each of the *oſſa malarum* is joined, by its ſuperior and internal orbitar proceſſes, to the *os frontis*, and to the orbitar proceſs of the *ſphenoid* bone, by the *tranſverſe* ſuture.—By the edge between the internal and inferior orbitar proceſſes, to the *maxillary* bone, by the *internal orbitar* ſuture.—By the ſide between the maxillary and inferior orbitar proceſs, again to the maxillary bone, by the *external orbitar*

ſuture.——By the zygomatic proceſs, to the *os temporum*, by the *zygomatic* ſuture.

The cheek bones are entire, and fully oſſified in all their parts in infants.

OSSA MAXILLARIA SUPERIORA, are the largeſt bones, and conſtitute the far greater part of the upper jaw, which has appropriated the name of *maxillaria* to them. The figure of one of them, or of the two when joined, is ſo irregular, that words can ſcarce give an idea of it.

The proceſſes of each *os maxillare* may be reckoned ſeven.—The *firſt* is the long naſal one at its upper and fore-part, which is broad below, and turns ſmaller, as it riſes upwards, to make the ſide of the noſe.——At the root of this a tranſverſe ridge may be obſerved within the noſtrils, which ſupports the fore-part of the upper edge of the *os ſpongioſum inferius*.—The *ſecond* is produced backwards and outwards from the root of the naſal proceſs, to form the lower ſide of the orbit; and therefore may be called *orbitar*.—The edge of this orbitar proceſs, and the ridge of the naſal one, which is continued from it, make a conſiderable portion of the external circumference of the orbit.—From the proper orbitar proceſs, a very rough triangular ſurface is extended downwards and outwards, to be connected to the cheek-bone; and therefore may be called the *malar* proceſs, from the loweſt protuberant part of which ſome ſhare of the maſſeter muſcle takes its riſe.—Behind the orbitar proceſs, a large tuberoſity or bulge of the bone appears, which is eſteemed the *fourth* proceſs.—On the internal

part of this we often meet with a ridge, almoſt of the ſame height with that in the naſal proceſs, which runs tranſverſely, and is covered by a ſimilar ridge of the *palate* bone, on which the back part of the upper edge of the *os ſpongioſum inferius* reſts.——The convex back-part of this tuberoſity is rough for the origin of part of the external *pterygoid* muſcle (*a*), and more internally is ſcabrous, where the palate and ſphenoid bones are joined to it.——That ſpongy protuberance * at the lower circumference of this bone, where the ſockets for the teeth are formed, is reckoned the *fifth*.—The *ſixth* is the horizontal plate, which forms the greater part of the baſe of the noſtrils, and roof of the mouth; its upper ſurface, which belongs to the noſtrils, is very ſmooth, but the other below is arched and rough, for the ſtronger adheſion to the membrane of the mouth, which is ſtretched upon it, and in chewing, ſpeaking, *&c.* might otherwiſe be liable to be ſeparated.—The *ſeventh* riſes like a ſpine from the inner edge of the laſt, and forms a ſmall part of the partition of the noſtrils.

The depreſſions in each *maxillary* bones are, 1. A ſinuoſity behind the orbitar proceſs, made by the *temporal* muſcle. 2. A pit immediately before the ſame proceſs, where the origin of the *muſculus elevator labiorum communis*, and *elevator labii ſuperioris*, with a branch of the fifth pair of nerves, are lodged ſecurely. 3. The hollow arch of the palate. 4. The ſemicircular great notch, or entry to the lower part of

I the

(*a*) Albin. de oſſib. § 79.

* φατνια.

the noſtrils, betwixt the root of the naſal proceſs and ſpine of the palate-plate.—Below this, the fore-part of the bone is flatted, or ſometimes hollowed by the *muſculus depreſſor labii ſuperioris*. 5. Sockets for the teeth †: The number of theſe ſockets are uncertain; for the ſame number of teeth is not in all people, and the four backmoſt teeth of each ſide of each jaw vary greatly in their number of roots; and when the teeth of a living perſon fall out, or are taken away, the ſockets fill up with an oſſeous net-work, which becomes ſolid afterwards.--6. The *lacrymal foſſa* in the *naſal proceſs*, which aſſiſts the *os unguis* to form a paſſage for the *lacrymal duct*. This part of the bone forming this *foſſa* is ſo firm and ſtrong, that a ſurgeon ſcarce can perforate it with the ordinary inſtruments for the *fiſtula lacrymalis*, and therefore ought to avoid it in doing this operation.——Immediately on the outſide of this, there is a ſmall depreſſion, from which the inferior or leſſer oblique muſcle of the eye has its origin (*a*), 7. The canal on the upper part of the great tuberoſity within the orbit, which is almoſt a compleat hole; in this a branch of the ſuperior maxillary nerve paſſes.———Beſides theſe the ſuperior ſurface of the great bulge is concave, to receive the under part of the eye.—Immediately above the tranſverſe ridge in the naſal proceſs, a ſmall hollow is formed by the *os ſpongioſum*.——In ſome ſubjects, the naſal proceſs has a ſmall round pit above the lacrymal duct,

† Βόθρια, ὀλμίσκοι, alveoli, foſſulæ, mortariola, fræna, locelli, cavæ, praſſepiola, loculamenta.

(*a*) Winſlow, Expoſition anatomique des os ſecs, § 276.

where the little tendon or ligament of the orbicular muſcle of the eye lids is inſerted. It is this tendon, and not the tendon of the larger oblique muſcle of the eye, which there is ſome hazard of cutting in the operation of the *fiſtula lacrymalis.*

The holes of this bone are two proper and two common, which are always to be found, beſides ſeveral others, whoſe magnitude, number, *&c.* are uncertain.——The firſt of the proper is the *external orbitar*, immediately below the orbit, by which the infra orbitar branch of the ſecond branch of the fifth pair of nerves, and a ſmall artery, come out, after having paſſed in the canal, at the bottom of the orbit, deſcribed *numb.* 7. of the depreſſions.——This hole is often double, and that when the nerve has happened to ſplit before it has eſcaped from the bone.—The ſecond is the *foramen inciſivum*, juſt behind the fore-teeth which, at its under part, is one irregular hole common to both the *maxillary* bones when they are joined; but, as it aſcends, ſoon divides into two, three, or ſometimes more holes; ſome of which open into each noſtril. Thro' them ſmall arteries and veins, and a twig of the ſecond branch of the fifth pair of nerves paſs, and make a communication between, or join the lining coats of the noſe and mouth.—In ſome ſubjects, *Steno's* duct may be traced ſome way on the ſide of theſe paſſages next to the noſe, and ſmall orifices may be obſerved opening into the mouth.

The firſt common hole is that which appears at the inner ſide of the back-part of the *tube-*

roſity and of the ſockets of the teeth, and is formed by a *foſſa* in this bone, and a correſponding one in the *os palati:* through it a nerve, which is a branch of the ſecond branch of the fifth pair, runs to the palate.——The other common hole is the great ſlit in the outſide of the orbit deſcribed already, as the ſecond common hole of the ſphenoid bone.

On the naſal proceſs often holes may be obſerved for the paſſage of veſſels to the ſubſtance of the bones; and, at the back-part of each tuberoſity, ſeveral *foramina* are placed, for the tranſmiſſion of nerves to the cavity within: but theſe are uncertain.

All the body of the *maxillary* bone is hollow, and leaves a large *ſinus* a-kin to the *frontal* and *ſphenoid*, which is commonly, but unjuſtly, called *antrum Highmorianum* *. When the *os maxillare* is ſingle or ſeparated from all the other bones of a ſkeleton, its *antrum* appears to have a large aperture into the noſtrils; but, in a recent ſubject, it is ſo covered at its back-part, by the *palate* bone: in the middle, by the *os ſpongioſum inferius*; before, by a ſtrong membrane, that one or ſometimes two holes, ſcarce larger than a crow-quill, are only left at the upper part; which, after a ſhort winding progreſs, open into the noſtrils between the two *oſſa ſpongioſa*.—At the bottom of this cavity, we may often obſerve ſome protuberances, in which the ſmall points of the roots of the teeth are contained (*a*).—This cavern and the ſockets of the teeth are often divided by

* Genæ.

(*a*) Highmore, Diſquiſ. anat. lib. 3. part. 2. cap. 1.

the interpoſition only of a very thin bony plate, which is liable to be eroded by acrid matter collected in the *antrum*, or to be broke in drawing a tooth (*a*). The ſymptoms of a collection of matter here naturally lead us to the practice of pulling out the teeth, and piercing through this plate into the *antrum*, to procure an evacuation of the collected matter: by which conſiderable ſervice is frequently done (*b*).

The *maxillary ſinuſes* have the ſame uſes as the *frontal* and *ſphenoidal*; and the ſituation of the *ſinuſes* is ſuch, that the liquor drilling from them, from the cells of the ethmoid and palate bones, and from the lacrymal ducts, may always moiſten all the parts of the membrane of the *nares* in the different ſituations which the head is in.

Though the membranes which line the *frontal*, *ſphenoidal*, and *maxillary ſinuſes*, are continuations of the one which covers the bones within the noſe; yet they are much thinner than it is, and have ſo much ſmaller veſſels, than the injection which makes the membrane of the noſe red all over, fills only ſome few veſſels of the *maxillary ſinuſes*, and ſcarce is obſerved in the *frontal* and *ſphenoidal*. Are not the larger veſſels intended for a more plentiful ſecretion of a viſcid liquor to defend the membrane from the effects of the *perflatus*, which is conſtantly through the noſe? Are not the membranes which have the ſmalleſt veſſels, *cæteris paribus*, the moſt ſenſible? Are not

(*a*) Highmore, ibid.

(*b*) Cowper in Drake's anthropol. book 3, chap. 10.—Medical Eſſays and obſerv. vol. 5. art 30.

not many phænomena of ſwelling, inflammations of theſe parts, *megrim*, *polypi*, *&c.* depending on this ſtructure of theſe membranes?

The ſubſtance of the *oſſa maxillaria* is compact and firm, except at the inferior proceſſes, in which the teeth are lodged, where it is very ſpongy.

The *maxillary* bones are joined above by the upper ends of their naſal proceſſes to the *os frontis*, by the *tranſverſe* future;—at the ſides of theſe proceſſes, to the *oſſa unguis*, by the *lacrymal* ſutures;—to the *naſal* bones by the *lateral naſal* ſutures;—by their orbitar proceſſes, to the *cheek* bones, by the *external orbitar* ſutures;—by the internal ſides of the internal orbitar proceſſes, to the *oſſa plana*, by part of the *ethmoidal* ſuture;——by the back part of the tuberoſities, to the *palate* bones, by the *futuræ palato maxillares*;——by the poſterior edges of their palatine *lamellæ*, to the *oſſa palati*, by the *tranſverſe* palate future;——by their naſal *ſpines*, to the *vomer*, by the *ſpinous* ſuture;——by their ſockets, to the teeth by *gomphoſis*;——by the internal edge of the palate plate, to one another, by the *longitudinal* palate-ſuture; on the upper and fore-part of which a furrow is left for receiving the cartilage which forms the partition of the noſtrils;——between the fore-part of the noſtrils and mouth, to each other, by the *myſtachial* future;——ſometimes they are connected to the *oſſa ſpongioſa inferiora*, by a plain concretion or union of ſubſtance.

Theſe bones form the greater part of the noſe and of the roof of the mouth, and a conſiderable

conſiderable ſhare of the orbit. They contain ſixteen teeth, give riſe to muſcles, tranſmiſſion to nerves, &c. as mentioned in the deſcription of their ſeveral parts.

In each of the *maxillary* bones of a new-born child, the external orbitar proceſs is hollow with remarkable holes in it;——there are five ſockets for the teeth, of which the two poſterior are very large, and, when divided by a ſecond croſs partition, make the number of ſockets ſix (*a*).——The palate-plate is cribriform about the middle.——The great tuberoſity is not formed.——inſtead of the *antrum*, there is only an oblong depreſſion at the ſide of the noſtrils.

OSSA PALATI are commonly deſcribed as two ſmall ſquare bones, at the back-part of the palate or roof of the mouth, though they are of much greater extent, being continued up the back-part of the noſtrils to the orbit (*b*). Each palate-bone may therefore be divided into four parts, the palate ſquare bone, the pterygoid proceſs, naſal *lamella*, and orbitar proceſs.

The ſquare bone is unequally concave, for enlarging both the mouth and cavity of the noſe. The upper part of its internal edge riſes in a ſpine, after the ſame manner as the palate-plate of the *maxillary* bone does, to be joined with the *vomer*.——Its anterior edge is unequally ragged, for its firmer connection with

(*a*) Albin. Oſteogen. tab. 5. fig. 45.——Ungebav. de dentit. ſecund. jun. § 1.

(*b*) Euſtach. tab. 47. fig. 1, 3, 6, 7, 8.——Vidus Vidius, de Anat. lib. 2. cap. 2. explicat. tab. 6. fig. 19.—Winſlow Memoires de l'acad. des ſciences, 1720.

with the palate-proceſs of the *os maxillare*.—The internal edge is thicker than the reſt, and of an equal ſurface, for its conjunction with its fellow of the other ſide.———Behind, this bone is ſomewhat in form of a creſcent, and thick, for the firm connection of the *velum pendulum palati*; the internal point being produced backwards, to afford origin to the *palato-ſtaphylinus* or *azygos* muſcle.——This ſquare bone is well diſtinguiſhed from the *pterygoid* proceſs by a perpendicular *foſſa*, which, applied to ſuch another in the *maxillary* bone, forms a paſſage for the palatine branch of the fifth pair of nerves; and by another ſmall hole behind this, through which a twig of the ſame nerve paſſes.

The *pterygoid* proceſs is ſomewhat triangular, having a broad baſe, and ending ſmaller above. The back-part of this proceſs has three *foſſæ* formed in it; the two lateral receive the ends of the two plates of the ſphenoid bone, that are commonly compared to a bat's wing; the middle *foſſa* makes up a part of what is commonly called the *foſſa pterygoidea*; the fore ſide of this palatine pterygoid proceſs is an irregular concave, where it receives the back part of the great *tuberoſity* of the *maxillary* bone.—Frequently ſeveral ſmall holes may be obſerved in this triangular proceſs, particularly one near the middle of its baſe, which a little above communicates with the common and proper holes of this bone already taken notice of.

The *naſal lamella* of this bone is extremely thin and brittle, and riſes upwards from the upper ſide of the external edge of the ſquare-bone, and from the narrow extremity of the

pteryoid proceſs; where it is ſo weak, and, at the ſame time, ſo firmly fixed to the *maxillary* bone, as to be very liable to be broken in ſeparating the bones.—From the part where the plate riſes, it runs up broad on the inſide of the *tuberoſity* of the *maxillary* bone, to form a conſiderable ſhare of the ſides of the *maxillary ſinus*, and to cloſe up the ſpace between the *ſphenoid* and the great bulge of the maxillary bone, where there would otherwiſe be a large ſlit opening into the noſtrils (*a*). From the middle internal ſide of this thin plate, a croſs ridge placed on ſuch another of the maxillary bone is extended; on it, the back part of the *os ſpongioſum inferius* reſts.—Along the outſide of this plate, the perpendicular *foſſa* made by the palate nerve is obſerveable.

At the upper part of this naſal plate, the palate bone divides into two proceſſes, which I already named *orbitar*;—between which and the body of the *ſphenoid* bone, that hole is formed, which I mentioned as the laſt of the holes common to the *ſphenoid* bone.—Sometimes this hole is wholly formed in the *os palati*, by a croſs plate going from the one orbitar proceſs to the other. A nerve, artery, and vein belonging to the noſtrils paſs here.—The anterior of the two orbitar proceſſes is the largeſt, and has its fore-part contiguous to the back-part of the *maxillary ſinus*, and its upper ſurface appears in the bottom of the orbit, behind the back part of the *os maxillare* and *planum*.

(*a*) Albin. de oſſib. § 88.

num.—It has cells behind reſembling thoſe of the *ethmoid* bone, to which it is contiguous; it is placed on the aperture of the *ſinus ſphenoidalis* ſo as to leave only a round hole at its upper fore-part.—The other part of the orbitar proceſs is extended along the internal ſide of the upper back part of the maxillary *tuberoſity*, to the baſe of the *ſphenoid* bone, between the root of the *proceſſus azygos* and the pterygoid proceſs.

The palate ſquare part of this palate-bone, and its pterygoid proceſs, are firm and ſtrong, with ſome *cancelli*; but the naſal plate and orbitar proceſſes are very thin and brittle.

The palate-bones are joined to the *maxillary*, by the fore edge of the palate ſquare bone, by the *tranſverſe palate* ſuture: By their thin naſal plates, and part of their orbitar proceſſes, to the ſame bones, by the *palato maxillares* ſutures:—By their *pterygoid* proceſſes, and back-part of the *naſal plates*, to the *alæ veſpertilionum*, by the *ſphenoid* ſuture:—By the tranſverſe ridges of the naſal plates, to the *oſſa ſpongioſa inferiora*, by contact; hence frequently there is an intimate union of the ſubſtance of theſe bones in old ſculls:—By the orbitar proceſſes, to the *oſſa plana* and *cellula ethmoideæ*, by the *ethmoid* ſuture:——To the body of the *ſphenoid* bone, by the *ſphenoid* ſuture:—By the internal edge of the ſquare bones, to each other, by the *longitudinal* palate ſuture: and by their naſal ſpines, to the *vomer*, by the *ſpinous* ſuture.

The palate-bones form part of the palate, noſtrils, orbits, and *foſſæ pterygoidæ*, and they

they cover part of the *ſinus maxillares*, *ſphenoidales*, and *ethmoidei*.

Theſe bones are very complete in a new-born infant, the naſal plates being then thicker and ſtronger than in adults; but the orbitar proceſſes have not the cells which appear in the bones of adults.

When we are acquainted with the hiſtory of theſe bones, the reaſon is evident, why the eyes are ſo much affected in ulcers of the palate, as to be often attended with blindneſs, which frequently happens in an ill-managed *lues venerea*; or why, on the other hand, the palate ſuffers from an *ægylops* (*a*).

OSSA TURBINATA, or *ſpongioſa inferiora*, reſemble the ſuperior *oſſa ſpongioſa* in ſhape and ſubſtance, but have their anterior and upper edges contiguous to the tranſverſe ridges of the naſal proceſſes of the *maxillary* and *palate bones*.—From their upper ſtreight edge, two ſmall proceſſes ſtand out: the poſterior, which is the broadeſt, deſcends to cover ſome of the *antrum Highmorianum*; the anterior riſes up to join the *os unguis*, and to make part of the *lacrymal duct*.

Below the ſpongy bones already mentioned, there are ſometimes two others, one in each noſtril, which ſeem to be a production of the ſides of the maxillary *ſinus* turned downwards (*b*). When this third ſort of ſpongy bones is found, the middle one of the three in each noſtril is the largeſt, and the loweſt is the ſmalleſt.

(*a*) Hoffman. in Ephemerid. German. cent. 1. and 2. obſerv. 135.

(*b*) Cowper in Drake's Anthropolog, book 3, chap. 10.

eſt.—Beſides all theſe, thereare often ſeveral other ſmall bones ſtanding out into the noſtrils, that, from their ſhape, might alſo deſerve the name of *turbinata*, but are uncertain in their bulk, ſituation, and number *(a)*.

The names of theſe bones ſufficiently declare their ſpongy ſubſtance, which has no firm external plate covering it.

They are joined to the *oſſa maxillaria*, *palati*, and *unguis* in old ſubjects, by a firm union of ſubſtance; and as this happens alſo frequently in people of no great age, ſome *(b)* are of opinion, that they ſhould be eſteemed part of the plate bones; others *(c)* think, that ſince their upper edge is continued by a plate to a part of the *os ethmoides*, they ought to be eſteemed to be a part of this bone.

Their uſe is, to ſtraiten the noſtrils, to afford a large ſurface for extending the organ of ſmelling, to cover part of the *antra maxillaria*, and to aſſiſt in forming the under part of the lacrymal ducts, the orifices of which into the noſe are concealed by theſe bones.

The *oſſa turbinata* are nearly complete in a new born infant.

VOMER, or bone reſembling a ploughſhare, is the thirteenth of the upper jaw, without a fellow, forming the lower and back parts of the partition of the noſe *(d)*.

(a) Santorin. Obſervat. anatomic. cap. 5. § 9.
(b) Id. ibid. cap. 5. § 7.
(c) Hunauld. in Memoires de l'acad. des ſciences, 1730.
(d) Columb. de re anat. lib. 1. cap. 8.—Fallop. Obſervat. anatom.

The figure of this bone is an irregular rhomboid.—Its ſides are flat and ſmooth.——Its poſterior edge appears in an oblique direction at the back part of the noſtrils.——The upper one is firmly united to the baſe of the *ſphenoid* bone, and to the naſal plate of the *ethmoid*; and, when it can be got ſeparated, is hollow, for receiving the *proceſſus azygos* of the *ſphenoid*.—The anterior edge has a long furrow in it, where the middle cartilage of the noſe enters.—The lower edge is firmly united to the naſal ſpines of the maxillary and palate bones.———Theſe edges of this bone are much thicker than its middle, which is as thin as the fineſt paper; by which, and the firm union or connection this bone has above and below, it can very ſeldom be ſeparated entire in adults: But, in a child, it is much more eaſily ſeparated entire, and its ſtructure is more diſtinctly ſeen; wherefore I ſhall examine all its parts of ſuch a ſubject.

Its ſituation is not always perpendicular, but often inclined and bended to one ſide, as well as the naſal plate of the *ethmoid* bone.

The *vomer* is convex at its upper part, and then is ſtreight, as it is extended downwards and forwards where it is compoſed of two plates; the edges of which have a great number of ſmall proceſſes, diſpoſed ſomewhat like the teeth of a ſaw, but more irregularly, and ſeveral of them are reflected back. Between theſe plates a deep *foſſa* is left, which, ſo far as the top of the curvature, is wide, and has ſtrong ſides, for receiving the *proceſſus azygos* of the *ſphenoid* bone. Beyond the arch forwards,

wards, the *foſſa* is narrower and ſhallower gradually to the point of the bone, receiving for ſome way the naſal *lamella ethmoidea*; which, after the oſſification is complete, is ſo cloſely united to the *vomer* by the little proceſſes piercing into its ſubſtance, as to prevent any ſeparation; on which account it has been eſteemed by ſome *(a)* a part of the ethmoid bone. The middle cartilage of the noſe fills up what remains of the *foſſa* at its fore-part.——The poſterior edge of the *vomer*, which appears above the back part of the palate bones, is broader above; but as it deſcends forwards, becomes thinner, though it is ſtill ſolid and firm.—The lower edge of this bone, which reſts on the naſal ſpine of the *palate* and maxillary bones, has a little furrow on each ſide of a ſmall middle ridge, anſwering to the ſpines of the bones of different ſides, and the interſtice between them. This edge, and the upper one meet in the pointed fore-end of this bone.

The body of the *vomer* has a ſmooth ſurface, and ſolid, but thin ſubſtance; and towards its ſides, where it is thickeſt, ſome *cancelli* may be obſerved, when the bone is broken.

It is joined above to the *ſphenoid* and *ethmoid* bones, and to the middle cartilage of the noſe, by *ſchindyleſis*;—below, to the maxillary and palate bones, by the *ſpinous* ſuture.

The *vomer* divides the noſtrils, enlarges the organ of ſmelling, by allowing place for expanding the membrane of the noſe on its ſides, and ſuſtains the palate plates of the *max-*

(a) Lieutaud. Eſſais anatomiques 1. ſect. l'os ethmoide.

illary and palate bones, which otherwiſe might be in hazard of being preſſed into the noſtrils; while the *vomer* is ſecured from ſhuffling to one ſide or other by the double *ſchindyleſis*, by which it is joined to the bones above and below.

Theſe then are all the bones which compoſe the upper jaw, except the teeth, which are ſo much a-kin to thoſe of the lower jaw, that I chuſe to make one deſcription ſerve for both, in which the differences obſervable in them ſhall be remarked, after the ſecond part of the face, the lower jaw, is examined; becauſe the ſtructure of the teeth cannot be well underſtood, until the caſe in which they are ſet is explained.

MAXILLA INFERIOR *, the lower jaw conſiſts only of one moveable bone, and ſixteen teeth incaſed into it.

This bone, which is ſomewhat of the figure of the *Greek* letter *υ*, is ſituated at the lower part of the face, ſo as its convex middle part is forwards, and its legs are ſtretched back. It is commonly divided into the chin, ſides, and proceſſes.—The *chin* is the middle fore-part, the extent of which to each ſide is marked on the external ſurface by the holes obſervable there, and internally by the beginning of an oblique ridge.—Beyond theſe the ſides appear, and are continued till the bone, by bending upwards, begins to form the proceſſes.

On the fore part of the *chin*, a tranſverſe ridge appears in the middle, on each ſide of which

* Τένος, σιαγων, mandibula, facies.

which the *muſculi quadrati*, or *depreſſores labii, inferioris*, and the *levatores labii inferioris*, depreſs the bone: and below theſe prints, a ſmall riſing may be obſerved, where the *depreſſores* commence.—On the back part of the chin, ſometimes three, always two, ſmall protuberances appear in the middle. To the uppermoſt, when it is ſeen, the *frænum* of the tongue is connected. From the middle one, the *muſculi genioglofſi* riſe: and from the loweſt, the *geniohyoidei* have their origin. Below the laſt, we ſee two rough ſinuoſities formed by the *digaſtric* muſcles.

At the lower and fore-part of the external ſurface of each ſide of the lower jaw, a ſmall eminence may be obſerved, where the *depreſſor labiorum communis* riſes. Near the upper edge of the ſide a ridge runs length ways, to which the under part of the *muſculus buccinator* is connected.—Internally, towards the upper edge of each ſide, another ridge appears, from which the *mylohyoidei* have their origin, and to which the internal membrane of the gums adheres.

In the upper edge of both chin and ſides are a great many deep pits or ſockets, for receiving the roots of the teeth. The number and magnitude of theſe ſockets are various, becauſe of the different number, as well of the teeth themſelves, as of their roots, in different people. Theſe ſockets in this lower jaw, as well as in the upper one, are leſs deep as old age comes on; when freed from the teeth by any means, they are ſome time after filled up with an oſſeous net work, which at laſt becomes

entire ſolid, and as ſmooth as any other part of the bone; ſo that in a great many old jaws one cannot obſerve a veſtige of the ſockets: But then the jaw becomes leſs, and much narrower *(a)*.—Hence we may know why the chin and noſe of edentulous people are much nearer than before the teeth were loſt, while their lips either fall in towards the mouth, or ſtand prominent forwards.—When new teeth are protruded, new ſockets are formed *(b)*.—The lower edge of the chin and ſides is ſmooth and equal, and is commonly called the *baſe* of the lower jaw.—The ends of the baſe, where the jaw turns upwards, are called its *angles*; the external ſurface of each of which has ſeveral inequalities upon it, where the *maſſeter* muſcle is inſerted; as the internal ſurface alſo has, where the *pterygoideus internus* is inſerted, and a ligament extended from the *ſtyloid* proceſs of the temporal bone is fixed.

The proceſſes are two on each ſide—The anterior ſharp thin *coronoid* ones have the *crotaphite* muſcles inſerted into them.—The poſterior proceſſes or *condyles* * terminate in an oblong ſmooth head, ſupported by a *cervix*. The heads whoſe greateſt length is tranſverſe, and whoſe convexity is turned forwards, are tipped with a cartilage, as the articulated parts of all other moved bones are.—The forepart of the root and neck of theſe *condyloid* proceſſes are a little hollow and rough, where the external *pterygoid* muſcles are inſerted.

The

(a) Veſal. Anat. lib. 1. cap. 10.
(b) Fallop. Obſervat. anat.
* Articulatorii.

The holes of the lower jaw are two on each ſide: one at the root of the proceſſes internally, where a large branch of the third branch of the fifth pair of nerves enters with an artery, and a vein returns. A ſmall ſharp proceſs frequently jutts out backwards from the edge at the fore part of this hole, to which a ligament extended from the temporal bone is fixed *(a)*, which ſaves the nerve and veſſels from being too much preſſed by the *pterygoid* muſcles.——From the lower ſide of this hole, either a ſmall ſuperficial canal or a furrow deſcends, where a branch of the nerve is lodged, in its way to the *mylo-hyoideus* muſcle and ſublingual gland *(b)*.—The other hole is external, at the confines of the chin, where branches of the nerve and veſſels come out.—The canal betwixt theſe two holes is formed in the middle of the ſubſtance of the bone, and is pierced by a great number of ſmall holes by which the nerves and blood veſſels of the *cancelli* and teeth paſs. This canal is continued a little further than the external hole at the chin.—On account of the veſſels and nerves in the lower jaw, fractures of it may be attended wtth dangerous ſymptoms.

The ſurface of the lower jaw is hard and firm, except at the ſpongy ſockets, where however it is ſtronger than the upper jaw.—Its internal ſubſtance is cellular, without any ſolid partition between the *cancelli* in its middle.—At the baſe, eſpecially of the chin, where

(a) Weitbrecht. Syndeſmolog. fig. 32. 1.
(b) Palfyn. Anat. chirur. traite 5. chap. 6.

where this bone is moſt expoſed to injuries, the ſolid ſides of it are thick, compact, and hard.

The lower jaw generally receives the roots of ſixteen teeth into its ſockets, by *gomphoſis*; and its *condyloid* proceſſes, covered with cartilage, are articulated with the *temporal* bones, in a manner that is not commonly deſcribed right: For, as was already mentioned in the deſcription of the temporal bones, not only the fore part of the cavity between the *zygomatic*, *auditory*, and *vaginal* proceſſes, but alſo the adjoining tubercle at the root of the *zygomatic* proceſs of each *os temporum* is covered with a ſmooth cartilage, for this articulation.—Here alſo an intermediate moveable cartilage is placed, which being thin in the middle, and thick at the edges, is concave on both ſides; and is connected ſo firmly by ligaments to each *condyle*, as to follow the motions of the *condyle*; and ſo looſely to the *temporal* bone, as readily to change its ſituation from the cavity to the tubercle, and to return again; while the common ligament of the articulation affords ſpace enough for ſuch a change of place backwards and forwards; but, like other ligaments of the joints by *ginglimus*, is ſtrong and ſhort at the ſides, to confine the lateral motions.

When therefore the teeth of both jaws coincide, the *condyles* are lodged ſecurely in the temporal cavities, but their motions to either ſide muſt be confined both by the firmneſs of the ligaments, and the riſing brims which are on each ſide of the cavities.———

When

When the jaw is brought directly forwards, the condyle and intermediate cartilages descend and advance forwards upon the tubercles.—In this situation the lateral motions are a little more free than in the former one, from the want of rising brims to stop the condyles.—When the fore teeth of the lower jaw are moved forwards, and to a side, the condyle of the opposite side is either advanced from the cavity of the tubercle, while the condyle of the same side remains in the cavity; or if both condyles are on the tubercles, when the jaw is moved obliquely to a side, the condyle of the side to which the motion is made slides back from the tubercle to the cavity.—When the mouth is opened by the descent of the lower jaw, the fore part of it, where the *depressing* muscles are fixed, is drawn backwards, as well as downwards, while resistance is made to the angles moving backwards by the *masseter* and *internal pterygoid* muscles, and, at the same time, the *external pterygoid* draw the condyles and their moveable cartilages forwards; and therefore, when the mouth is opened, the condyles are carried forwards upon the tubercles, and the axis of motion of the bone is a little above its angles. But in this situation there is less resistance, than in any other, to the condyles luxating forwards; a disease which seldom happens, except when people are gaping too wide; and therefore the common practice of nurses, who support the jaw of infants when they are yawning, is reasonable.—

In

In chewing there is a ſucceſſion of the motions above deſcribed *(a)*.

Here a general remark may be made, That wherever moveable cartilages are found in joints, either the articulated bones are of ſuch a figure, or ſo joined and fixed by their ligaments, that little motion would be allowed without ſuch cartilages; or elſe ſome motions are neceſſary to the right uſe of the member, which the form of the articulation would not otherwiſe admit of. This will more fully appear after the other joints with ſuch cartilages are deſcribed.

In a child born to the full time, the lower jaw is compoſed of two bones, connected by a thin cartilage in the middle of the chin, which gradually oſſifies, and the two bones intimately unite.—In each of theſe bones there are five or ſix ſockets for teeth as in the upper jaw.

After I have thus deſcribed the incaſement of the teeth, the inſertion of ſo many muſcles of the tongue, and of the *os hyoides*, the connection of the membrane of the tongue to the maxillary bone, and the motions of this bone; it is eaſy to ſee, that the lower jaw muſt be a principal inſtrument in manducation, deglutition, and ſpeech.

The *TEETH* are the hard white bodies placed in the ſockets of both jaws. Their number is generally ſixteen above, and as many

(*a*) For a more full account of this articulation, vid. Edinburgh Medical eſſays and obſerv. vol. 1. art. 11. and vol. 3. art 13.—Memoires de l'acad. des ſciences, 1744.

ny below; though ſome people have more, other have fewer.

The broad thick part of each tooth which appears without the ſocket, is the *baſe* or body*. ——The ſmaller proceſſes ſunk into the *maxillæ*, are the *roots* or *fangs*, which become gradually ſmaller towards the end fartheſt from the baſe, or are nearly conical, by which the ſurface of their ſides divides the preſſure made on the baſes, to prevent the ſoft parts, which are at the ſmall points of the ſockets, to be hurt by ſuch preſſure.—At the place where the baſe ends, and the roots begin, there is generally a ſmall circular depreſſion, which ſome call the *neck* or *collar*.

Without the gums the teeth are covered with no membrane, and they are ſaid to have no proper *perioſteum* within the ſockets; but that is ſupplied by the reflected membrane of the gums; which, after a good injection, may be evidently ſeen in a young ſubject, with the veſſels from it penetrating into the ſubſtance of the teeth; and it may be diſcovered in any tooth recently pulled, by macerating it in water (*a*). The adheſion of this membrane to theſe roots is ſtrengthened by the ſmall furrows obſervable on them.

Each tooth is compoſed of its *cortex*, or *enamel*, and an internal bony ſubſtance. The *cortex* has no cavity or place for marrow; and is ſo ſolid and hard, that ſaws or files can with difficulty make impreſſion on it. It is thickeſt upon the baſe, and gradually, as the roots

* Corona.

(*a*) Cowper, Anatom. explicat. tab. 92. fig. 7. lit. E.

roots turn ſmaller, becomes thinner, but not proportionally to the difference of the ſize of the baſe and roots.———The fibres of this enamel are all perpendicular to the internal ſubſtance, and are ſtreight on the baſe, but at the ſides are arched with a convex part towards the roots (*a*); which makes the teeth reſiſt the compreſſion of any hard body between the jaws, with leſs danger of breaking theſe fibres, than if they had been ſituated tranſverſely. The ſpongy ſockets in which the teeth are placed likewiſe ſerve better to prevent ſuch an injury, than a more ſolid baſe would have done.———Notwithſtanding the great hardneſs of this *cortex*, it is waſted by manducation. Hence the ſharp edges of ſome teeth are blunted, and made broad, while the rough ſurfaces of others are made ſmooth and flat, as people advance in life.

The bony part of the teeth has its fibres running ſtreight according to the length of the teeth. When it is expoſed to the air, by the breaking or falling off of the hard *cortex*, it ſoon corrupts. And thence carious teeth are often all hollow within, when a very ſmall hole appears only externally.

The teeth have canals formed in their middle, wherein their nerves and blood-veſſels are lodged; which they certainly need, being conſtantly waſted by the attrition they are ſubjected to in manducation, and for their further growth, not only after they firſt appear, but even in adults; as is evident when a tooth is taken

(*a*) Havers Oſteolog. nov. diſ. 1.

taken out: For then the oppoſite one becomes longer, and thoſe on each ſide of the empty ſocket turn broader; ſo that when the jaws are brought together, it is ſcarce obſervable where the tooth is wanting (*a*).

The veſſels are eaſily traced ſo long as they are in the large canal, but can ſcarce be obſerved in their diſtribution from that to the ſubſtance of the teeth of adults. Ruyſch (*b*) however affirms, that after injection he could trace the arteries into the hardeſt part of the teeth; and Leewenhoek (*c*) ſuſpected the fibres of the *cortex* to be veſſels. In children I have frequently injected the veſſels of the teeth as far as their baſe: And in ſuch as are not intirely oſſified, one can with a lucky injection fill ſo many veſſels, as to make both the outſide and inſide of the cortical part appear perfectly red. ——This plentiful ſupply of veſſels muſt expoſe the teeth to the ſame diſorders that attack other vaſcular parts; and ſuch teeth as have the greateſt number of veſſels, muſt have the moſt numerous chances of being ſeized with theſe diſeaſes.

Every root of each tooth has ſuch a diſtinct canal, with veſſels and nerves in it. Theſe canals in the teeth with more than one root, come nearer each other, as they approach the baſe of the tooth; and at laſt are only ſeparated by very thin plates, which being generally incompleat, allow a communication of all the

(*a*) Ingraf. de tumor. cap. 1. p. 24, 25, 26.
(*b*) Theſaur. 10. num. 27.
(*c*) Arcan. natur. continuat. epiſt. p. 3.

the canals; and frequently one common cavity only appears within the baſe, in which a pulpy ſubſtance compoſed of nerves and veſſels is lodged. The condition therefore of the nerves here bears a ſtrong analogy to that of the cutaneous nerves which ſerve for the ſenſation of touching.

The entry of the canals for theſe veſſels is a ſmall hole placed a little to a ſide of the extreme point of each root; ſometimes, eſpecially in old people, this hole is entirely cloſed up, and conſequently the nerves and blood-veſſels are deſtroyed (*a*).

The teeth are ſeen for a conſiderable time in form of *mucus* contained in a membrane; afterwards a thin cortical plate, and ſome few oſſeous layers appear within the membrane, with a large cavity filled with *mucus* in the middle; and gradually this exterior ſhell turns thicker, the cavity decreaſes, the quantity of *mucus* is leſſened, and this induration proceeds till all the body is formed; from which the roots are afterwards produced.

In young ſubjects, different *ſtamina* or rudiments of teeth are to be obſerved. Thoſe next the gums hinder ordinarily the deeper-ſeated ones from making their way out, while theſe prevent the former from ſending out roots, or from entering deep into the bony ſockets of the jaws; by which they come to be leſs fixed.

Children are ſeldom born with teeth; but at two years of age they have twenty; and their number does not increaſe till they are about

(*a*) De la Hire Hiſtoire de l'acad. des ſciences, 1699.

about ſeven years old, when the teeth that firſt made their way through the gums are thruſt out by others that have been formed deeper in the jaw, and ſome more of the teeth begin to diſcover themſelves farther back in the mouth. About fourteen years of age, ſome more of the firſt crop are ſhed, and the number is increaſed.——This ſhedding of the teeth is of good uſe; for if the firſt had remained, they would have ſtood at a great diſtance one from another; becauſe the teeth are too hard in their outer cruſt, to increaſe ſo faſt as the jaws do. Whereas both the ſecond layer, and the teeth that come out late, meeting, while they are ſoft, with a conſiderable reſiſtance to their growth in length, from thoſe ſituated upon them, neceſſarily come out broad, and fit to make that cloſe guard to the mouth †, which they now form.

The teeth are joined to the ſockets by *gomphoſis*, and the gums contribute to fix them there; as is evident by the teeth falling out when the gums are any way deſtroyed, or made too ſpongy; as in the *ſcurvy* or *ſalivations*: whence ſome (*a*) claſs this articulation with the *ſyſſarcoſis*.

The uſes of the teeth are to maſticate our aliment, and to aſſiſt us in the pronunciation of ſeveral letters.

Though the teeth ſo far agree in their ſtructure, yet, becauſe of ſome things wherein they differ, they are generally divided into three claſſes, *viz.* *inciſores*, *canini*, and *molares*.

The

† Φραγμος.

(*a*) Drake's Anthropolog. book 4. chap. 3.

The *inciſores* * are the four fore-teeth in each jaw, receiving their name from their office of cutting our aliment; for which they are excellently adapted, being each formed into a ſharp-cutting edge at their *baſe*, by their fore ſide turning inwards there, while they are ſloped down and hollowed behind †; ſo that they have a form of wedges; and therefore their power of acting muſt be conſiderably increaſed.——Seeing in the action of the *inciſores*, a perpendicular compreſſion is only neceſſary, without any lateral motion, they are not ſo firmly fixed in their ſockets as the other teeth are, each having only one ſhort root, but that is broader from before backwards, than to either ſide, to have the greateſt ſtrength where it is expoſed to the ſtrongeſt force applied to it (*a*).

The *inciſores* of the upper jaw, eſpecially the two middle ones ‡, are broader and longer generally than thoſe of the under jaw.

In a new-born infant, the outer ſhell of the body of theſe teeth is only hardened.——Afterwards, when the *ſtamina* of two ſets are formed, each has its own ſocket, thoſe neareſt to the edge of the gums being placed more forward, and the others are lodged farther back within the jaw-bones.

Canini

* Γελασῖνοι, τομίκοι, διχαςῆρες, κτένες, τομεῖς, προωσθιοί, ὀξεῖς, riſorii, quaterii, primi, primores, anteriores, acuti.

† Ὀλμίσκος.

(*a*) Lettre ſur l'oſteologie, aſcribed to Du Verney.

‡ Duales.

Canini *, from the reſemblance to dogs tuſks, are one on each ſide of the *inciſores* in each jaw.——The two in the upper jaw are called *eye-teeth*, from the communication of nerves which is ſaid to be betwixt them and the eyes.——The two in the lower jaw are named *angular* or *wike teeth*, becauſe they ſupport the angles of the mouth.

The *canini* are broader, longer, and ſtronger, than the *inciſores*.——Their baſes are formed into a ſharp edge, as the *inciſores* are; only that the edge riſes into a point in the middle.—Each of them has generally but one long root, tho' ſometimes they have two (*a*). The roots are crooked towards the end.——The *canini* of the upper jaw are larger, longer, and with more crooked roots, than thoſe of the under jaw.—The form of their baſe is fit both for piercing and cutting, and the long crooked root of each makes it ſecure in the ſocket.

The *canini* of a child are in much the ſame condition as the *inciſores* are.

The *dentes molares*, or *grinders* †, which have got their name becauſe they grind our food, are generally five in each ſide of each jaw; in all twenty. Their baſes are broader, more ſcabrous, and with a thinner cortical ſubſtance, than the other teeth. They have alſo more roots, and as theſe roots generally divaricate from each other, the partitions of the ſockets between them bear a large ſhare of the great

* Κυνόδοντες, riſorii, fractorii, collateries, columellares.
(*a*) Fauchard, Chirurgien dentiſte, chap 1.
† Μυλιται, γόμφοι, μύλοι πλατεῖς, φραξῆρες, maxillaers, menſales, clavales, buccarum.

great preſſure they ſuffer, and hinder it to act on their points (*a*).

The baſe of the firſt grinder has an edge pointed in the middle, on its outſide, reſembling the *canini*; from which it ſlopes inwards till it riſes again into a point.——It has generally but one root, which ſometimes is long and crooked at its point.

The ſecond *dens molaris* has two points on its baſe, riſing near equally on its out and inſide.——It has two roots, either ſeparate or run together, but ſhorter than the root of the firſt.——Theſe two anterior grinders are much ſmaller than the three that are placed farther back in the mouth.

The third and fourth are very broad in their baſes, with four or five points ſtanding out; and they have three or more roots.

The fifth, called commonly *dens ſapientiæ* *, from its coming through the gums later than the other grinders, has four points on its baſe, which is not ſo large as the baſe of the third and fourth, and its roots are leſs numerous.

The *inciſores* of the upper jaw, being broader than thoſe of the lower jaw, make the ſuperior grinders to be placed ſo much farther back than the lower ones, that when they are brought together, by ſhutting the mouth, the points of the grinders of the one jaw enter into the depreſſions of the oppoſite grinders, and they are all equally applied to each other, notwithſtanding the inequality of their ſurface.

The

(*a*) Lettre ſur l'oſteologie.

* Σωφρονιςῆρες, κραντῆρες, ὀψίγονοι, ſenſus, intellectus, ſecotini, ætatem complentes, genuini, moderatores.

The numerous roots of the *dentes molares* prevent their looſening by the lateral preſſure they ſuffer in grinding; and as the ſockets in the upper jaw are more ſpongy, and the teeth are more liable, by their ſituation, to fall out (*a*), the grinders there have more numerous and more ſeparated roots that in the lower jaw (*b*). The number however of the roots of the teeth of both jaws is very uncertain; ſometimes they are more, ſometimes fewer; frequently ſeveral roots are joined together; at other times they are all diſtinct. The diſpoſition of ſuch as are diſtinct is alſo various; for in ſome the roots ſtand out ſtreight, in others they ſeparate, and in others again they are crooked inward. When the roots are united, we can ſtill diſtinguiſh them, by remarking the number of ſmall holes at their points, which determine the number of roots each tooth ought to be reckoned to have.

At the time of birth, only two *dentes molares* in each jaw have begun to oſſify, and that at little more than the baſe, which has ſeveral ſharp points ſtanding out from it.—The temporaneous grinders are placed more directly upon the internal ſet than the other two claſſes are; ſometimes there is a piece of the bone of the jaws between the two ſets; in other children, the two ſets have no bone interpoſed between them.

From what has been ſaid, the anſwers to the following queries may be given.

Why

(*a*) Galen. de oſſib. cap. 5.
(*b*) Fauchard. Chirurg. dent. chap. 1.

Why are children ſubject to ſalivation, fever, convulſion, vomiting, purging, &c. when their teeth are breeding or cutting the gums?

Why in children do the *dentes inciſores* firſt cut the gums, the *canini* next, and *molares* laſt?

Why do children ſhed their teeth?

Wherefore have theſe *temporaneous* teeth generally no roots, or very ſmall ones?

Why have theſe firſt teeth ſometimes roots, and that more frequently in teeth pulled by art than in thoſe which are ſhedded by nature (*a*)?

Why do theſe roots frequently come outwards through the gums?

Whence come *butter* or *buck* teeth?

How do theſe teeth ſometimes go into the natural row with the others, after pulling a rotten tooth near them?

How have ſome people got two rows of teeth in one or both jaws (*b*)?

Why do the teeth of old people looſen, and then drop out entire?

Whence ariſe the new ſets of teeth which ſeveral old people obtain (*c*)?

Why are not the gums of toothleſs old people torn by the hard ſockets in chewing?

Why are the teeth inſenſible when ſlightly filed or raſped?

How come they to be ſenſible of heat or cold, to be ſet on edge by acids, or to give an

(*a*) Fauchard. Chirurgien dentiſte. p. 7.
(*b*) Blaſ. Comment. ad Veſling. Syntagm. cap. 1. 3.
(*c*) Hoffman. in Van. Horn. microcoſm. p. 38.

an uneaſy ſenſation when gritty or ſandy ſubſtances are rubbed between them?

Why does a perſon who has a pained tooth imagine it longer than any other?

What is the reaſon of ſome perſons dying convulſed, upon raſping or filing down an over grown tooth *(a)*?

How do the teeth break and moulder away without any pain in ſome people and not in others?

What parts are affected in the tooth-ach?

What are the cauſes of the tooth-ach?

May worms be reckoned among theſe cauſes *(b)*?

Why are the *dentes molares* moſt ſubject to that diſeaſe?

In what different manners ought the ſeveral claſſes of teeth to be extracted when ſuch an operation is neceſſary?

Whence proceeds the violent obſtinate *hemorrhagy* which ſometimes attends the drawing of teeth *(c)*?

Why is it more difficult and dangerous to draw the eye teeth than any other?

What makes it impoſſible frequently to draw *grinders* without bringing away part of the jaw bone with them, or breaking the fangs?

(a) Bartholin. Anat. reformat. lib. 4. cap. 12.

(b) Jacob. in Act. Hafn. vol. 5. obſ. 107.—Pechlin. Obſerv. medic. lib. 2. obſ. 36.—Bartholin. Hiſt. medic. cent. 3. hiſt. 96.

(c) Pare. livre 6. chap. 2.———Rolfinc. lib. 2. cap. 27. & 30.———Moebii Fundam. medicin. cap. 9.—Ephemerid. German. dec. 1. ann. 3. obſ. 319.—Fauchard. Chirurg. dentiſte, tom. 1. chap. 23. obſerv.

Why do teeth ſoon replaced after being extracted, become again fixed in the ſockets *(a)* ?

According to the diviſion made of the ſkeleton, we ſhould now proceed to the deſcription of the trunk of the body. But muſt firſt conſider a bone, which cannot well be ſaid to belong to either the head or the trunk; nor is it immediately joined to any other, and therefore is very ſeldom preſerved with ſkeletons. However, it is generally deſcribed by authors after the bones of the face: In obedience therefore to the prevailing method, I ſhall next examine the ſtructure of

The *OS HYOIDES**, which is ſituated horizontally between the root of the tongue and the *larynx*. It is properly enough named *hyoides*, from the reſemblance it bears to the *Greek* letter *υ*, and may, for a clearer demonſtration of its ſtructure, be diſtinguiſhed into its *body*, *cornua*, and *appendices*.

The body is the middle broad part, convex before, and hollow behind.——The convex fore-part is divided into two, by a ridge, into the middle of which the *mylo-hyoidei*, and into the ſides the *ſtylo-hyoidei*, muſcles are inſerted.—Above the ridge, the bone is horizontal, but pitted in the middle by the inſertion of the two *genio-hyoidei* muſcles, and a little hollowed more laterally by the *baſio-gloſſi*.—Below the ridge, it is convex, but a little

(a) De la Motte Chirurgie, tom. 1. chap. 4. obſ. 2.—— Fauchard, Chirurgien dentiſte, tom. 1. chap. 29.

* Hyptyloides Lambdoides, παραγλώτη, φαρυγγετερον os gutturis, os linguæ, os morſus Adami, aſſeſſor, os laude, bicorne.

little flatted in the middle by the *ſterno hyoidei*, and pitted more externally by the *coraco-hyoidei*.—The concavity behind faces backwards and downwards to receive the *thyroid* cartilage, when the *larynx* and the *os hyoides* are pulled towards each other by the action of the *ſterno-hyoidei* and *hyothyroidei* muſcles; and to its upper edge, the ligamentous membranes of the *epiglottis*, tongue, and *thyroid* cartilage, are fixed.

The *cornua* of the * *os hyoides* are ſtretched backwards from each ſide of its body, where often a ſmall furrow points out the former ſeparation; for in young ſubjects, the body and *cornua* are not one continued ſubſtance, as they come afterwards to be in adults.—Theſe *cornua* are not always ſtreight, nor of equal length; their two plain ſurfaces ſtand obliquely ſloping from above outwards and downwards.—Into the external, the *ceratoglossus* is inſerted above, and the *thyro-hyoideus* muſcle below; and to the one behind, the ligamentous membrane of the tongue and *larynx* adheres. Each of the *cornua* becomes gradually ſmaller, as it is extended from the baſe; but ends in a round tubercle, from which a moveable cartilage ſtands out, which is connected to the upper proceſs of the *cartilago thyroidea*.

Where the body of the *os hyoides* joins on each ſide with its *cornua*, a ſmall ſtyliform proceſs called *appendix* †, riſes upwards and backwards, into which the *muſculi ſtylo-hyoidei alteri*, and part of the *hyo-gloſſi* muſcles are fix-

* Crura, latera inferiora.

† Cruia ſuperiora, latera ſuperiora, oſſa graniformia.

ed. From each of them a ligament is ſometimes extended to the *ſtyloid* proceſſes of the temporal bones, to keep the *os hyoides* from being drawn too much forwards or downwards. The part of this ligament next to theſe proceſſes ſometimes forms into ſeveral cartilages, which afterwards oſſify in old people. *Ruyſch (a)* ſays that he has ſeen this oſſification continued as far up as the ſtyloid proceſſes, which were therefore joined to the *os hyoides*, by *anchyloſis*.

The ſubſtance of the *os hyoides* is cellular, but covered with a firm external plate, which is of ſufficient ſtrength to bear the actions of ſo many muſcles as are inſerted into it.

It is not articulated with any bone of the body, except by means of the muſcles and ligaments mentioned.

The uſe of the *os hyoides*, is to ſerve as a ſolid lever for the muſcles to act with, in raiſing or depreſſing the tongue and larynx, or in enlarging and diminiſhing the capacity of the *fauces*.

At birth, this bone is in a cartilaginous ſtate; excepting a ſmall point of bone in the middle of its body, and in each of the *cornua*.—— The *appendices* frequently remain cartilaginous many years.

OF

(a) Adverſ. anat. dec. 3. § 9

OF THE TRUNK.

THE *TRUNK* consists of the *spine*, *pelvis*, and *thorax*.

The *SPINE* * is the long pile of bones extended from the *condyles* of the *occiput* to the end of the rump. It somewhat resembles two unequal pyramids joined in a common base. It is not, however, streight; for its upper part being drawn backwards by strong muscles, it gradually advances forwards, to support the *œsophagus*, vessels of the head, &c. Then it turns backwards, to make place enough for the heart and lungs. It is next bended forwards, to support the *viscera* of the *abdomen*. It afterwards turns backwards, for the enlargement of the *pelvis*. And, lastly, it is reflected forwards, for sustaining the lowest great gut.

The *spine* is commonly divided into *true* and *false vertebræ*; the former constituting the long upper pyramid, which has its base below, while the *false vertebræ* make the shorter lower pyramid, whose base is above.

The *TRUE VERTEBRÆ* † are the twenty four upper bones of the *spine*, on which the several motions of the trunk of our bodies are performed; from which use they have justly got their name.

Each of these *vertebræ* is composed of its body and processes.

* Ῥαχις νῶτον ἄκανθα, ἱέρα σύριγξ, σωλην, tergum, hominis carina.

† Στροφεις, σφόιγγες, spondyli, ossa orbiculata, ossa vertebrata, verticula.

The body is the thick ſpongy fore part, which is convex before, concave backwards, horizontal and plain in moſt of them above and below.——Numerous ſmall holes, eſpecially on the fore and back part of their ſurface, give paſſage to their veſſels, and allow the ligaments to enter their ſubſtance.—The edges of the body of each *vertebra* are covered, eſpecially at the fore-part, with a ring of bone firmer and more ſolid than the ſubſtance of the body any where elſe. Theſe rings ſeem to be joined to the *vertebræ* in the form of *epiphyſes*, but are alledged by ſome *(a)* to be the ligaments oſſified. They are of great uſe in preventing the ſpongy bodies from being broken in the motions of the trunk.

Between the bodies of each two adjoining *vertebræ*, a ſubſtance between the nature of ligament and cartilage is interpoſed; which ſeems to conſiſt of concentrical curve fibres, when it is cut horizontally; but when it is divided perpendicularly, the fibres appear oblique and decuſſating each other *(b)*.—The outer part of the intervertebral ligaments is the moſt ſolid and hard; and they gradually become ſofter till they are almoſt in the form of a glairy liquor in the center; and therefore theſe ſubſtances were not improperly called *mucous ligaments* by the ancients *(c)*. The external fibrous part of each is capable of being greatly extended, and of being compreſſed into a very

(*a*) Fallop. Obſervat. anatom.

(*b*) Blancard, Anat. reform. cap. 32.--Weitbrecht, Syndeſmolog. ſect. 4. § 15.

(*c*) Galen, de uſu part. lib. 12. cap. 16.

a very ſmall ſpace, while the middle fluid part is incompreſſible, or nearly ſo; and the parts of this ligament between the circumference and center approach in their properties to either, in proportion to their more ſolid or more fluid texture. The middle point is therefore a *fulcrum*, or *pivot*, on which the motion of a ball and ſocket may be made, with ſuch a gradual yielding of the ſubſtance of the ligament, in which ever direction our ſpines are moved, as ſaves the body from violent ſhocks, and their dangerous conſequences *(c)*. ——This ligamento-cartilaginous ſubſtance is firmly fixed to the horizontal ſurfaces of the bodies of the *vertebræ*, to connect them, in which it is aſſiſted by a ſtrong membranous ligament, which lines all their concave ſurface, and by a ſtill ſtronger ligament that covers all their anterior convex ſurface.

We may lay it down as a general rule, notwithſtanding ſome exceptions, That the *bodies* of the *vertebræ* are ſmaller, and more ſolid above, but as they deſcend, they appear larger and more ſpongy; and that the cartilages between them are thick, and the ſurrounding ligaments ſtrong in proportion to the largeneſs of the *vertebræ*, and to the quantity of motion they perform: by which diſpoſition, the greater weight is ſupported on the broadeſt beſt ſecured baſe, and the middle of our body is allowed a large and ſecure motion.

From each ſide of the body of each *vertebra*, a bony bridge is produced backwards, and to a ſide; from the poſterior end of which, one

(c) Medical eſſays and obſerv. vol. 5. art. 28.

ſlanting proceſs riſes and another deſcends; the ſmooth, and what is generally the flatteſt ſide of each of theſe four proceſſes, which are called the *oblique* *, is covered with a ſmooth cartilage; and the two lower ones of each *vertebra* are fitted to, and articulated with the two upper or aſcending oblique proceſſes of the *vertebra* below, having their articular ligaments fixed into the rough line round their edges.

From between the oblique proceſſes of each ſide the *vertebra* is ſtretched out laterally into a proceſs that is named *tranſverſe*.

From the back part of the roots of the two oblique, and of the tranſverſe proceſs of each ſide, a broad oblique bony plate is extended backwards, where theſe meet, the ſeventh proceſs of the *vertebræ* takes its riſe, and ſtands out backwards: This being generally ſharp pointed and narrow edged, has therefore been called *ſpinal* proceſs; from which this whole chain of bones has got its name.

Beſides the common ligament which lines all the internal ſurface of the ſpinal proceſſes, as well as of the bodies, there are particular ligaments that connect the bony bridges and proceſſes of the contiguous *vertebræ* together.

The ſubſtance of the proceſſes is conſiderably ſtronger and firmer, and has a thicker external plate than the bodies of the *vertebræ* have.

The ſeven proceſſes form a concavity at their fore-part, which, joined to the one at the back part of the bodies, makes a great hole, and the holes of all the *vertebræ* form a long large

* Articu. latorii. minimi.

large conduit *, for containing the *ſpinal marrow*.——In the upper and lower edge of each *lateral bridge*, there is a notch. Theſe are ſo adapted to each other in the contiguous *vertebræ*, as to form a round hole in each ſide between each two *vertebræ*, through which the nerves that proceed from the *ſpinal* marrow and its blood veſſels paſs.

The articulations then of theſe true *vertebræ* are plainly double; for their bodies are joined by the intervening cartilage above deſcribed, and their oblique proceſſes being tipped with cartilage, are ſo connected by their ligaments, as to allow a ſmall degree of motion to all ſides. Hence it is evident, that their center of motion is altered in different poſitions of the trunk: For when we bow forwards, the upper moved part bears entirely on the bodies of the *vertebræ*: If we bend back, the oblique proceſſes ſupport the weight: If we recline to one ſide, we reſt upon the oblique proceſſes of that ſide and part of the bodies: If we ſtand erect, all the bodies and oblique proceſſes have their ſhare in our ſupport.

Hence it follows, 1. That becauſe the joints of which the ſpine is compoſed are ſo numerous, the *ſpinal* marrow, nerves, blood veſſels, *&c.* are not liable to ſuch compreſſion and over-ſtretching in the motion of the trunk of the body, as they would otherwiſe be, ſince ſeveral *vertebræ* muſt be concerned in every motion of the ſpine; and therefore a very ſmall curvature is made at the conjunction of

* Ιερα συριγξ, σωγήν, Canalis.

any two *vertebræ* (*a*). 2. That an erect poſture is the ſureſt and firmeſt, becauſe the ſurface of contact of the *fulcra* is largeſt, and the weight is moſt perpendicular to them (*b*). 3. That the muſcles which move the ſpine act with greater force in bringing the trunk to an erect poſture, than in drawing it to any other: for in bending forwards, backwards, or to a ſide, the muſcles which perform any of theſe actions are nearer the center of motion; conſequently the lever with which they act is ſhorter, than when the center of motion is on the part of the *vertebræ*, oppoſite to that where theſe muſcles are inſerted; which is the caſe in raiſing the trunk. This is extremely neceſſary; ſince in the deflections of the ſpine from a perpendicular bearing, the weight of the body ſoon inclines it which way we deſign; whereas, in raiſing us erect, this great weight muſt be more than counteracted. 4. In calculating the force exerted by the muſcles which move the ſpine, we ſhould always make allowance for the action of the cartilages between the *vertebræ*, which, in every motion from an erect poſture, muſt be ſtretched on one ſide, and compreſſed on the other, to both which they reſiſt; whereas, in raiſing the trunk, theſe cartilages aſſiſt by their ſpringy force (*c*). 5. We are hence naturally led into the reaſon of our heighth of ſtature increaſing in the morning,

(*a*) Galen de uſu part. lib. 12. cap. 12.
(*b*) Paaw de offib. part. 2. cap. 2.
(*c*) Borelli, de motu animal. pars 1. ſchol. ad propoſ. 58. Parent. Hiſtoire de l'acad. des ſciences, 1702.

ing, and diminiſhing at night (*a*): for the intermediate cartilages of the *vertebræ* being preſſed all day long by the weight of our body, become more compact and thin in the evening; but when they are relieved from this preſſure in the night, they again expand themſelves to their former thickneſs; and ſeeing the bulk of any part muſt vary according to the different diſtenſion or repletion of the veſſels compoſing it, we may underſtand how we become taller after a plentiful meal, and decreaſe after faſting or evacuations (*b*). 6. From the different articulations of the bodies, and oblique proceſſes of the *vertebræ*, and the different ſtrength of the ligaments, it is plain, that they are formed ſo as to allow much larger motion forwards than backwards: this laſt being of much leſs uſe, and might be dangerous, by overſtretching the large blood-veſſels that are contiguous to the bodies of the *vertebræ* (*c*). 7. The intervertebral cartilages ſhrivelling as they become more ſolid by age, is the cauſe why old people generally bow forwards, and cannot raiſe their bodies to ſuch an erect poſture as they had in their youth.

The *true vertebræ* ſerve to give us an erect poſture; to allow ſufficient and ſecure motion to the head, neck, and trunk of the body, and to ſupport and defend the bowels, and other ſoft parts.

At the ordinary time of birth, each *vertebra* conſiſts of three bony pieces, connected by cartilages;

(*a*) Waſſe Philoſoph. tranſact. numb. 383. art 1.
(*b*) Abbe Fontenu Hiſtoire de l'acad. des ſciences, 1725.
(*c*) Galen. de uſu part. lib. 1. cap. 16.

cartilages; to wit, the *body*, which is not fully oſſified, and a long crooked bone on each ſide; on which we ſee a ſmall ſhare of the bony bridge, the oblique proceſſes compleat, the beginning tranſverſe proceſſes, and the oblique plate, but no ſpinal proceſſes, ſo that the teguments are in no danger of being hurt by the ſharp ends of theſe ſpinal proceſſes; while a child is in its bended poſture in the womb, nor while it is ſqueezed in the birth.

From this general mechaniſm of the ſpine, an account is eaſily deduced of all the different preternatural curvatures which the ſpine is capable of: for if one or more *vertebræ*, or their cartilages, are of unequal thickneſs in oppoſite ſides, the ſpine muſt be reclined over to the thinner ſide; which now ſuſtaining the greateſt ſhare of the weight, muſt ſtill be more compreſſed, conſequently hindered from extending itſelf in proportion to the other ſide, which, being too much freed of its burden, has liberty to enjoy a luxuriant growth. The cauſes on which ſuch an inequality of thickneſs in different ſides of the *vertebræ* depends may vary: for either it may be owing to an over-diſtenſion of the veſſels of one ſide, and from thence a preternatural increaſe of the thickneſs of that part; or which more commonly is the caſe, it may proceed from an obſtruction of the veſſels, by which the application of proper nouriſhment to the bony ſubſtance is hindered, whether that obſtruction depends on the faulty diſpoſition of the veſſels or fluids; or if it is produced by an unequal mechanical preſſure, occaſioned by a paralytic weakneſs

weakneſs of the muſcles and ligaments, or by a ſpaſmodic over-action of the muſcles on any ſide of the ſpine, or by people continuing long, or putting themſelves frequently into any poſture declining from the erect one: In all theſe caſes one common effect follows, to wit, the *vertebræ*, or their cartilages, or both, turn thick on that ſide where the veſſels are free, and remain thin on the other ſide where the veſſels are ſtraitened or obſtructed.——Whenever any morbid curvature is thus made, a ſecond turn, but in an oppoſite direction to the former, muſt be formed; both becauſe the muſcles on the convex ſide of the ſpine being ſtretched, muſt have a ſtronger natural contraction to draw the parts to which their ends are fixed, and becauſe the patient makes efforts to keep the center of gravity of the body perpendicular to its baſe, that the muſcles may be relieved from a conſtant violent contractile ſtate, which always creates uneaſineſs and pain.

When once we underſtand how theſe crooked ſpines are produced, there is little difficulty in forming a juſt prognoſis; and a proper method of cure may be eaſily contrived, which muſt vary as to the internal medicines, according to the different cauſes on which the diſeaſe depends: But one general indication muſt be purſued by ſurgeons; which is, to counteract the bending force, by increaſing the compreſſion on the convex part of the curvature, and diminiſhing it on the concave ſide. The manner of executing which in particular caſes muſt be different, and requires a very accurate examination

mination of the circumſtances both of the diſeaſe and patient. In many ſuch caſes, I have found ſome ſimple directions, as to poſtures in which the patient's body ſhould be kept, of very great advantage.

Though the *true vertebræ* agree in the general ſtructure which I have hitherto deſcribed; yet becauſe of ſeveral ſpecialities proper to a particular number, they are commonly divided into three claſſes, viz. *cervical*, *dorſal*, and *lumbar*.

The *cervical** are the ſeven uppermoſt *vertebræ*; which are diſtinguiſhed from the reſt by theſe marks.——Their bodies are ſmaller and more ſolid than any others, and flatted on the fore part, to make way for the *œſophagus*; or rather this flat figure is owing to the preſſure of that pipe, and to the action of the *longi colli* and anterior *recti* muſcles ——They are alſo flat behind, where ſmall proceſſes riſe, to which the internal ligaments are fixed.—— The upper ſurface of the body of each *vertebra* is made hollow, by a ſlanting thin proceſs which is raiſed on each ſide:——The lower ſurface is alſo excavated, but in a different manner; for here the poſterior edge is raiſed a little, and the one before is produced a conſiderable way.——Hence we ſee how the cartilages between thoſe bones are firmly connected, and their articulations are ſecure.

The cartilages between thoſe *vertebræ* are thick, eſpecially at their fore part; which is one

* Τραχηλος, αὐχὴν, colli.

one reaſon why the *vertebræ* advance forward as they deſcend, and have larger motion.

The oblique proceſſes of theſe bones of the neck more juſtly deſerve that name than thoſe of any other *vertebræ*. They are ſituated ſlanting; the upper ones having their ſmooth and almoſt flat ſurfaces facing obliquely backwards and upwards, while the inferior oblique proceſſes have theſe ſurfaces facing obliquely forwards and downwards.

The tranſverſe proceſſes of theſe *vertebræ* are framed in a different manner from thoſe of any other bones of the ſpine: For beſides the common tranſverſe proceſs riſing from between the oblique proceſſes of each ſide, there is a ſecond one that comes out from the ſide of the body of each *vertebræ*; and theſe two proceſſes, after leaving a circular hole for the paſſage of the cervical artery and vein, unite, and are conſiderably hollowed at their upper part, with riſing ſides, to protect the nerves that paſs in the hollow; and at laſt each ſide terminates in an obtuſe point, for the inſertion of muſcles.

The ſpinal proceſſes of theſe cervical bones ſtand nearly ſtreight backwards, are ſhorter than thoſe of any other *vertebræ*, and are forked or double at their ends; and hence allow a more convenient inſertion to muſcles.

The thick cartilages between the bodies of theſe *cervical vertebræ*, the obliquity of their *oblique* proceſſes, and the ſhortneſs and horizontal ſituation of their *ſpinal* proceſſes, all conſpire to allow them large motion.

The

The holes between the bony croſs bridges, for the paſſage of the nerves from the *ſpinal marrow*, have their largeſt ſhare formed in the loweſt of the two *vertebræ*, to which they are common.

So far moſt of the cervical *vertebræ* agree; but they have ſome particular differences, which oblige us to conſider them ſeparately.

The firſt, from its uſe of ſupporting the head, has the name of *atlas* *; and is alſo called *epiſtrophea*, from the motion it performs on the ſecond.

The *atlas*, contrary to all the other *vertebræ* of the ſpine, has no body; but, inſtead of it, there is a bony arch.——In the convex fore-part of which, a ſmall riſing appears, where the *muſculi longi colli* are inſerted; and, on each ſide of this protuberance, a ſmall cavity may be obſerved, where the *recti interni minores* take their riſe.——The upper and lower parts of the arch are rough and unequal, where the ligaments that connect this *vertebra* to the *os occipitis*, and to the ſecond *vertebra* are fixed.——The back part of the arch is concave, ſmooth, and covered with a cartilage, in a recent ſubject, to receive the tooth-like proceſs, of the ſecond *vertebra*.——In a firſt *vertebra* from which the ſecond has been ſeparated, this hollow makes the paſſage for the *ſpinal* marrow to ſeem much larger than it really is: On each ſide of it a ſmall rough ſinuoſity may be remarked, where the ligaments going to the ſides of the tooth-like proceſs of the following *vertebra*

† Ασφαγαλος.

vertebra are faſtened; and on each ſide, a ſmall rough protuberance and depreſſion is obſervable, where the tranſverſe ligament, which ſecures the tooth-like proceſs in the ſinuoſity, is fixed, and hinders that proceſs from injuring the *medulla ſpinalis* in the flections of the head.

The *atlas* has as little ſpinal proceſs as body; but, inſtead thereof, there is a large bony arch, that the muſcles which paſs over this *vertebra* at that place might not be hurt in extending the head. On the back and upper part of this arch there are two depreſſions, where the *recti poſtici minores* take their riſe; and at the lower part are two other ſinuoſities, into which the ligaments which connect this bone to the following one are fixed.

The ſuperior oblique proceſſes of this *atlas* are large, oblong, hollow, and more horizontal than in any other *vertebra*.——They riſe more in their external than internal brim; by which their articulations with the *condyloid* proceſſes of the *os occipitis* are firmer.——Under the external edge of each of theſe oblique proceſſes, is the *foſſa*, or deep open channel, in which the vertebral arteries make the circular turn, as they are about to enter the great *foramen* of the occipital bone, and where the tenth pair of nerves goes out.———In ſeveral bodies, I have ſeen this *foſſa* covered with bone.——The inferior oblique proceſſes extending from within outwards and downwards, are large, concave, and circular. So that this *vertebra*, contrary to the other ſix, receives the bones with

with which it is articulated both above and below.

The tranſverſe proceſſes here are not much hollowed or forked, but are longer and larger than thoſe of any other *vertebra* of the neck, for the origin and inſertion of ſeveral muſcles; of which thoſe that ſerve to move this *vertebra* on the ſecond have a conſiderable lever to act with, becauſe of the diſtance of their inſertion from the *axis* of revolution.

The hole for the *ſpinal marrow* is larger in this than in any other *vertebra*, not only on account of the *marrow* being largeſt here, but alſo to prevent its being hurt by the motions of this *vertebra* on the ſecond one.——This large hole, and the long tranſverſe proceſſes, make this the broadeſt *vertebra* of the neck.

The *condyles* of the *os occipitis* move forwards and backwards in the ſuperior oblique proceſſes of this *vertebra*; but from the figure of the bones forming theſe joints, it appears, that very little motion can here be allowed to either ſide; and there muſt be ſtill leſs circular motion.

In new-born children this *vertebra* has only the two lateral pieces oſſified; the arch, which it has at its fore-part inſtead of a body, being cartilaginous.

The ſecond *vertebra colli* is called *dentata*, from the tooth-like proceſs on the upper part of its body. Some authors call it *epiſtrophea*, but improperly, ſince this deſignation is only applicable to the firſt, which moves on this as on an axis.

The

The body of this *vertebra* is ſomewhat of a pyramidal figure, being large, and produced downwards, eſpecially at its fore ſide, to enter into a hollow of the *vertebra* below; while the upper part has a ſquare proceſs with a ſmall point ſtanding out from it. This it is that is imagined to reſemble a tooth *, and has given name to the *vertebra*.—The ſide of this proceſs, on which the hollow of the anterior arch of the firſt *vertebra* plays, is convex, ſmooth, and covered with a cartilage; and it is of the ſame form behind, for the ligament, which is extended tranſverſely from one rough protuberance of the firſt *vertebra* to the other, and is cartilaginous in the middle, to move on it.—A ligament likewiſe goes out in an oblique tranſverſe direction, from each ſide of the *proceſſus dentatus*, to be fixed at its other end to the firſt *vertebra*, and to the occipital bone; and another ligament riſes up from near the point of the proceſs to the *os occipitis*.

The ſuperior oblique proceſſes of this *vertebra dentata* are large, circular, very nearly in an horizontal poſition, and ſlightly convex, to be adapted to the inferior oblique proceſſes of the firſt *vertebra*.—A moveable cartilage is ſaid by ſome authors to be interpoſed between theſe oblique proceſſes of the firſt and ſecond *vertebra*; but I could never find it.——The inferior oblique proceſſes of this *vertebra dentata* anſwer exactly to the deſcription given of thoſe common to all the cervical *vertebra*.

The

* Conoides, pyrenoides, odontoides.

The tranſverſe proceſſes of the *vertebra dentata* are ſhort, very little hollowed at their upper part, and not forked at their ends; and the canals through which the cervical arteries paſs, are reflected outwards about the middle ſubſtance of each proceſs; ſo that the courſe of theſe veſſels may be directed towards the tranſverſe proceſſes of the firſt *vertebra*.—Had this curvature of the arteries been made in a part ſo moveable as the neck is, while they were not defended by a bone, and fixed to that bone, ſcarce a motion could have been performed without the utmoſt hazard of compreſſion, and a ſtop put to the courſe of the liquids, with all its train of bad conſequences. Hence we obſerve this ſame mechaniſm ſeveral times made uſe of, when there is any occaſion for a ſudden curvature of a large artery. This is the third remarkable inſtance of it we have ſeen. The firſt was the paſſage of the *carotids* through the *temporal* bones; and the ſecond was that lately deſcribed in the vertebral arteries, turning round the oblique proceſſes of the firſt *vertebra*, to come at the great hole of the occipital bone.

The ſpinal proceſs of this *vertebra dentata* is thick, ſtrong, and ſhort, to give ſufficient origin to the *muſculi recti majores*, and *obliqui inferiores*, and to prevent the contuſion of theſe and other muſcles in pulling the head back.

This ſecond *vertebra* conſiſts, at the birth, of four bony pieces: For, beſides the three which I already mentioned as common to all the *vertebræ*, the tooth-like proceſs of this bone is begun at this time to be oſſified in its middle,

middle, and is joined as an appendix to the body of the bone.———Leſt this appendix be bended or diſplaced, nurſes ought to keep the heads of new-born children from falling too far backwards by *ſtay-bands*, or ſome ſuch means, till the muſcles attain ſtrength ſufficient to prevent that dangerous motion.

When we are acquainted with the ſtructure and articulations of the firſt and ſecond *vertebræ*, and know exactly the ſtrength and connection of their ligaments, there is no difficulty in underſtanding the motions that are performed upon or by the firſt; though this ſubject was formerly matter of hot diſpute among ſome of the greateſt anatomiſts (*a*.) It is none of my purpoſe at preſent to enter into a detail of the reaſons advanced by either party; but to explain the fact, as any one may ſee it, who will remove the muſcles, which, in a recent ſubject, hinder the view of theſe two joints, and then will turn the head into all the different poſitions it is capable of. The head may then be ſeen to move forwards and backwards on the firſt *vertebra*, as was already ſaid, while the *atlas* performs the *circumgyratio* upon the ſecond *vertebra*; the inferior oblique proceſſes of the firſt *vertebra* ſhuffling eaſily in a circular way on the ſuperior oblique proceſſes of the ſecond, and its body or anterior arch having a rotation on the tooth-like proceſs, by which the perpendicular ligament that is ſent from the point of the tooth-like proceſs to the occipital bone is twiſted, while the lateral ligaments that fix the *proceſſus dentatus* to

(*a*) See Euſtach. de motu capitis.

to the ſides of the firſt *vertebra*, and to the *os occipitis*, are very differently affected; for the one upon the ſide towards which the face is turned by the *circumgyratio*, is much ſhortened and lax, while the oppoſite one is ſtretched and made tenſe, and yielding at laſt no more, prevents the head from turning any further round on this *axis*. So that theſe lateral ligaments are the proper *moderators* of the *circumgyratio* of the head here, which muſt be larger or ſmaller, as theſe ligaments are weaker or ſtronger, longer, or ſhorter, and more or leſs capable of being ſtretched.——Beſides the revolution on this *axis*, the firſt *vertebra* can move a ſmall way to either ſide; but is prevented from moving backwards and forwards, by its anterior arch, and by the croſs ligament, which are both cloſely applied to the tooth-like proceſs. Motion forwards here would have been of very bad conſequence, as it would have brought the beginning of the *ſpinal* marrow upon the point of the tooth-like proceſs.

The rotatory motion of the head is of great uſe to us on many accounts, by allowing us to apply quickly our organs of the ſenſes to objects: and the *axis* of rotation was altogether proper to be at this place; for if it had been at a greater diſtance from the head, the weight of the head, if it had at any time been removed from a perpendicular bearing to the ſmall very moveable joint, and thereby had acquired a long lever, would have broke the ligaments at every turn inconſiderately performed; or theſe ligaments muſt have been formed much ſtronger than could have been connect-

ed

ed to ſuch ſmall bones. Neither could this circular motion be performed on the firſt *vertebra* without danger, becauſe the immoveable part of the *medulla oblongata* is ſo near, as, at each large turn, the beginning of the *ſpinal* marrow would have been in danger of being twiſted, and of ſuffering by the compreſſion this would have made on its tender fibrils.

It is neceſſary to obſerve, that the *lateral* or *moderator* ligaments confine ſo much the motion of the firſt *vertebra* upon the ſecond, that, though this joint may ſerve us on ſeveral occaſions, yet we are often obliged to turn our faces farther round, than could be done by this joint alone, without the greateſt danger of twiſting the ſpinal marrow too much, and alſo of luxating the oblique proceſſes; therefore, in large turns of this kind, the rotation is aſſiſted by all the *vertebræ* of the neck and loins; and if this is not ſufficient, we employ moſt of the joints of the lower extremities.—This combination of a great many joints towards the performance of one motion, is alſo to be obſerved in ſeveral other parts of the body; notwithſtanding ſuch motions being generally ſaid to be performed by ſome ſingle joint only.

The third *vertebra* of the neck is by ſome called *axis*; but this name is applied to it with much leſs reaſon than to the ſecond.—This third, and the three below, have nothing particular in their ſtructure; but all their parts come under the general deſcription formerly given, each of them being larger as they deſcend.

The

The ſeventh * *vertebra* of the neck is near to the form of thoſe of the back, having the upper and lower ſurfaces of its body leſs hollow than the others:—The oblique proceſſes are more perpendicular;—neither ſpinal nor tranſverſe proceſſes are forked.—This ſeventh and the ſixth *vertebra* of the neck have the hole in each of their tranſverſe proceſſes more frequently divided by a ſmall croſs bridge, that goes between the cervical vein and artery, than any of the other *vertebræ*.

The twelve *dorſal* † may be diſtinguiſhed from the other *vertebræ* of the ſpine by the following marks.

Their bodies are of a middle ſize, betwixt thoſe of the neck and loins; they are more convex before than either of the other two ſorts; and are flatted laterally by the preſſure of the ribs, which are inſerted into ſmall cavities formed in their ſides. This flatting on their ſides, which makes the figure of theſe *vertebræ* almoſt an half oval, is of good uſe; as it affords a firm articulation to the ribs, allows the *trachea arteria* to divide at a ſmall angle, and the other large veſſels to run ſecure from the action of the vital organs.—Theſe bodies are more concave behind than any of the other two claſſes.—Their upper and lower ſurfaces are horizontal.

The cartilages interpoſed between the bodies of theſe *vertebræ* are thinner than in any other of

* Atlas quibuſdam, maxima, magna vertebra, prominens.

† Θωρακος, μεταφρένα, νῶτα, ὑποτραχήλια, antiſterni, pectoris, tergi.

of the *true vertebræ*; and contribute to the concavity of the ſpine in the thorax, by being thinneſt at their fore-part.

The *oblique* proceſſes are placed almoſt perpendicular; the upper ones ſlanting but a little forwards, and the lower ones ſlanting as much backwards.—They have not as much convexity or concavity as is worth remarking.—Between the oblique proceſſes of oppoſite ſides, ſeveral ſharp proceſſes ſtand out from the upper and lower parts of the plates which join to form the ſpinal proceſs; into theſe ſharp proceſſes ſtrong ligaments are fixed, for connecting the *vertebræ*.

The *tranſverſe* proceſſes of the *dorſal vertebræ* are long, thicker at their ends than in the middle, and turned obliquely backwards; which may be owing to the preſſure of the ribs, the tubercles of which are inſerted into a depreſſion near the end of theſe proceſſes.

The *ſpinal* proceſſes are long, ſmall pointed, and ſloping downwards and backwards; from their upper and back part a ridge riſes, which is received by a ſmall channel in the fore part of the ſpinal proceſs immediately above, which is here connected to it by a ligament.

The *conduit* of the *ſpinal* marrow is here more circular, but, correſponding to the ſize of that cord, is ſmaller than in any of the other *vertebræ*, and a larger ſhare of the holes in the bony bridges, for the tranſmiſſion of the nerves, is formed in the *vertebra* above, than in the one below.

The connection of the *dorſal vertebræ* to the ribs, the thinneſs of their cartilages, the

erect situation of the oblique processes, the length, sloping, and connection of the spinal processes, all contribute to restrain these *vertebræ* from much motion, which might disturb the actions of the heart and lungs; and, in consequence of the little motion allowed here the *intervertebral* cartilages sooner shrivel, by becoming more solid: And therefore, the first remarkable curvature of the spine observed, as people advance to old age, is in the least stretched *vertebræ* of the back; or old people first become round shouldered.

The bodies of the four uppermost *dorsal vertebræ* deviate from the rule of the *vertebræ* becoming larger as they descend; for the first of the four is the largest, and the other three below gradually become smaller, to allow the *trachea* and large vessels to divide at smaller angles.

The two uppermost *vertebræ* of the back, instead of being very prominent forwards, are flatted by the action of the *musculi longi colli* and *recti majores*.

The proportional size of the two little depressions in the body of each *vertebra* for receiving the heads of the ribs, seems to vary in the following manner; the depression on the upper edge of each *vertebra* decreases as far down as the fourth, and after that increases.

The transverse processes are longer in each lower *vertebra* to the seventh or eighth, with their smooth surfaces, for the tubercles of the ribs, facing gradually more downwards; but afterwards as they descend they become shorter, and

and the ſmooth ſurfaces are directed more upwards.

The ſpinous proceſſes of the *vertebræ* of the back become gradually longer and more ſlanting from the firſt, as far down as the eighth or ninth *vertebra*; from which they manifeſtly turn ſhorter and more erect.

The firſt **vertebra*, beſides an oblong hollow in its lower edge, that aſſiſts in forming the cavity wherein the ſecond rib is received, has the whole cavity for the head of the firſt rib formed in it.

The ſecond has the name of *axillary* †, without any thing particular in its ſtructure.

The eleventh ‡ often has the whole cavity for the eleventh rib in its body, and wants the ſmooth ſurface on each tranſverſe proceſs.

The twelfth ‖ always receives the whole head of the laſt rib, and has no ſmooth ſurface on its tranſverſe proceſſes, which are very ſhort.—The ſmooth ſurfaces of its inferior oblique proceſſes face outwards as the *lumbar* do.——And we may ſay, in general, that the upper *vertebræ* of the back loſe gradually their reſemblance to thoſe of the neck, and the lower ones come nearer to the figure of the *lumbar*.

The articulation of the *vertebræ* of the back with the ribs, ſhall be more particularly conſidered after the ribs are deſcribed. Only it

* Λοφία, gutturalis.
† Μασχαλιςὴρ.
‡ Α῾ρξιπὴς in neutram partem inclinans.
‖ Διασωςὴρ, præcingens.

may be proper now to remark, that the ligaments which ſerve that articulation aſſiſt in connecting the *vertebræ*.

The loweſt order of the *true vertebræ* is the *lumbar* *, which are five bones, that may be diſtinguiſhed from any others by theſe marks: 1. Their bodies, though of a circular form at their fore part, are ſomewhat oblong from one ſide to the other, which may be occaſioned by the preſſure of the large veſſels, the *aorta* and *cava*, and of the *viſcera*. The *epiphyſes* on their edges are larger, and therefore the upper and lower ſurfaces of their bodies are more concave than in the *vertebræ* of the back. 2. The cartilages between theſe *vertebrae* are much the thickeſt of any, and render the ſpine convex within the *abdomen*, by their greateſt thickneſs being at their fore-part. 3. The oblique proceſſes are ſtrong and deep; thoſe in oppoſite ſides being almoſt placed in parallel planes; the ſuperior, which are concave, facing inwards, and the convex inferior ones facing outwards: and therefore each of theſe *vertebrae* receives the one above it, and is received by the one below; which is not ſo evident in the other two claſſes already deſcribed. 4. Their tranſverſe proceſſes are ſmall, long, and almoſt erect, for allowing large motion to each bone, and ſufficient inſertion to muſcles, and for ſupporting and defending the internal parts. 5. Betwixt the roots of the ſuperior oblique and tranſverſe proceſſes, a ſmall protuberance may be obſerved, where

* Ὀσφὺς ἰξὺος, ψοιῶν, renum, lumborum.

where ſome of the muſcles that raiſe the trunk of the body are inſerted. 6. Their ſpinal proceſſes are ſtrong, ſtreight, and horizontal, with broad flat ſides, and a narrow edge above and below; this laſt being depreſſed on each ſide by muſcles. And at the root of theſe edges, we ſee rough ſurfaces for fixing the ligaments. 7. The canal for the numerous cords, called *cauda equina*, into which the ſpinal marrow divides, is rather larger in theſe bones than what contains that *marrow* in the *vertebrae* of the back. 8. The holes for the paſſage of the nerves are more equally formed out of both the contiguous *vertebrae* than in the other claſſes; the upper one furniſhes however the larger ſhare of each hole.

The thick cartilages between theſe *lumbar vertebrae*, their deep oblique proceſſes, and their erect ſpinal proceſſes, are all fit for allowing large motion; though it is not ſo great as what is performed in the neck; which appears from comparing the arches which the head deſcribes when moving on the neck, or the loins only.

The *lumbar vertebrae* as they deſcend, have their oblique proceſſes at a great diſtance from each other, and facing more backwards and forwards.

Both tranſverſe and ſpinal proceſſes of the middlemoſt *vertebrae* of the loins are longeſt and thickeſt; in the *vertebrae* above and below they are leſs: So that theſe proceſſes of the firſt*

* Νεφριτης, renalis.

and fifth * are the leaſt, to prevent their ſtriking on the ribs or *oſſa ilium*, or their bruiſing the muſcles in the motions of the ſpine.

The *epiphyſes* round the edges of the bodies of the *lumbar vertebrae* are moſt raiſed in the two loweſt, which conſequently make them appear hollower in the middle than the others are.

The body of the fifth *vertebra* is rather thinner than that of the fourth.—The ſpinal proceſs of this fifth is ſmaller, and the oblique proceſſes face more backwards and forwards than in any other *lumbar vertebra*.

After conſidering the ſtructure of the particular *vertebrae*, and their mutual connection, we may obſerve a ſolicitous care taken that they ſhall not be disjoined, but with great difficulty; for beſides being connected by ſtrong ligaments proportioned to the forces which are to be reſiſted, their bodies either enter ſo into each other, as to prevent their being diſplaced any way, as in the *vertebrae* of the neck; or they are propped on all ſides, as theſe of the *back* are by the ribs; or their ſurfaces of contact are ſo broad, as to render the ſeparation almoſt impracticable, as in the *loins*; while the depth and articulation of the oblique proceſſes are exactly proportioned to the quantity of motion which the other parts of the bones allow, or the muſcles can perform: Yet, as theſe oblique proceſſes are ſmall, and therefore not capable of ſo ſecure a conjunction as the larger bodies, they may ſooner yield to a disjoining force; but then their diſlocation is

* Ασχαλίτης, fulciens.

is not of near ſo bad conſequence as the ſeparation of the bodies would be. For, by the oblique proceſſes being diſlocated, the muſcles, ligaments, and ſpinal marrow are indeed ſtretched; but this marrow muſt be compreſſed, or entirely deſtroyed, when the body of the *vertebra* is removed out of its place.

The *FALSE VERTEBRÆ* compoſe the under pyramid of the *ſpine*. They are diſtinguiſhed from the bones already deſcribed juſtly enough by this epithet of *falſe*; becauſe tho' each bone into which they can be divided in young people, reſemble the *true vertebrae* in figure, yet none of them contribute to the motion of the trunk of the body; they being intimately united to each other in adults, except at their lower part, where they are moveable; whence they are commonly divided into two bones *os ſacrum*, and *coccygis*.

OS SACRUM *, is ſo called, from being offered in ſacrifice by the ancients, or rather becauſe of its largeneſs in reſpect of the other *vertebrae*.—This bone is of an irregular triangular ſhape, broad above, narrow below, convex behind, for the advantageous origin of the muſcles that move the *ſpine* and thigh backwards; and concave behind, for enlarging the cavity of the *pelvis*.——Four tranſverſe lines of a colour different from the reſt of the bone which are ſeen on its fore-part, are the marks of diviſion of the five different bones of which it conſiſts in young perſons.

* Ἱερόν, σποιδυλος μεγας Hippocrat. ὑποσποδυλοι, oribas. Πλατυ, latum, os clunium, clavium.

The fore-part of the *os ſacrum*, analogous to the bodies of the true *vertebræ*, is ſmooth and flat, to allow a larger ſpace for the contained bowels, without any danger of hurting them; or this flat figure may be owing to the equal preſſure of theſe bowels, particularly of the laſt gut.—The back part of it is almoſt ſtreight, without ſo large a cavity as the *vertebræ* have; becauſe the ſpinal marrow, now ſeparated into the *cauda equina*, is ſmall.—The bridges between the bodies and proceſſes of this bone, are much thicker, and in proportion ſhorter, than in the former claſs of bones.—The ſtrength of theſe croſs bridges is very remarkable in the three upper bones, and is well proportioned to the incumbent weight of the trunk of the body, which theſe bridges ſuſtain in a tranſverſe, conſequently an unfavourable, ſituation, when the body is erect.

There are only two oblique proceſſes of the *os ſacrum*; one ſtanding out on each ſide from the upper part of the firſt bone.—Their plain erect ſurfaces face backwards, and are articulated with the inferior oblique proceſſes of the laſt *vertebra* of the loins, to which each of theſe proceſſes is connected by a ſtrong ligament, which riſes from a ſcabrous cavity round their roots, where mucilaginous glands are alſo lodged.—Inſtead of the other oblique proceſſes of this bone, four rough tubercles are to be ſeen on each ſide of its ſurface behind, from which the *muſculus ſacer* has its origin.

The tranſverſe proceſſes here are all grown together into one large ſtrong oblong proceſs

on

on each ſide, which ſo far as it anſwers to the firſt three bones, is very thick, and divided into two irregular cavities, by a long perpendicular ridge.—The foremoſt of the two cavities has commonly a thin cartilaginous ſkin, covering it in the recent ſubject, and is adapted to the unequal protuberance of the *os ilium*, and a ſtrong ligament connects the circumference of theſe ſurfaces of the two bones.—The cavity behind is divided by a tranſverſe ridge into two, where ſtrong ligamentous ſtrings that go from this bone to the *os ilium* with a cellular ſubſtance containing *mucus*, are lodged

The tranſverſe proceſſes of the two laſt bones of the *os ſacrum* are much ſmaller than the former.—At their back part near their edge, a knob, and oblong flat ſurface give riſe to two ſtrong ligaments which are extended to the *os iſchium*; and are therefore called *ſacroſciatic*.

The ſpinal proceſſes of the three uppermoſt bones of the *os ſacrum* appear ſhort, ſharp, and almoſt erect, while the two lower ones are open behind; and ſometimes a little knob is to be ſeen on the fourth, though generally it is bifurcated, without the two legs meeting into a ſpine; in which condition alſo the firſt is often to be ſeen; and ſometimes none of them meet, but leave a *ſinus*, or rather *foſſa*, inſtead of a canal (*a*). The *muſculus latiſſimus* and *longiſſimus dorſi*, *ſacrolumbalis*, and *glutaeus maximus*, have part of their origins from theſe ſpinal proceſſes.

(*a*) Verheyen. Anat. tract. 5. cap. 9.—Sue Trad. d'oſteol. p. 127.

The canal between the bodies and proceſſes of this bone, for the *cauda equina*, is triangular; and becomes ſmaller as it deſcends, as the *cauda* alſo does.—Below the third bone, this paſſage is no more a compleat bony canal, but is open behind; and is only there defended by a ſtrong ligamentous membrane ſtretched over it, which, with the muſcles that cover it, and are very prominent on each ſide, is a ſufficient defence for the bundle of nerves within.

At the root of each oblique proceſs of this bone, the notch is conſpicuous, by which, and ſuch another in the laſt *vertebra* of the loins, a paſſage is left for the twenty fourth ſpinal nerve; and, in viewing the *os ſacrum*, either before or behind, four large holes appear in each ſide, in much the ſame height, as where the marks of the union of its ſeveral bones remain. Some of the largeſt nerves of the body paſs through the anterior holes; and ſuperficial grooves running outwards from them in different directions, ſhew the courſe of theſe nerves.—From the intervals of theſe grooves, the *pyriformis* muſcle chiefly riſes.—The holes in the back part of the bone are covered by membranes which allow ſmall nerves to paſs through them.—The two uppermoſt of theſe holes, eſpecially on the fore-ſide, are the largeſt; and as the bone deſcends, the holes turn ſmaller. Sometimes a notch is only formed at the lower part in each ſide of this bone; and in other ſubjects there is a hole common to it and the *os coccygis*, through which the twenty ninth pair of ſpinal nerves paſſes; and frequently a bony bridge is formed on the back part

part of each ſide by a proceſs ſent up from the back part of the *os coccygis*, and joined to the little knobs which the laſt bone of the *os ſacrum* has inſtead of a ſpinal proceſs. Under this bridge or *jugum*, the twenty ninth pair of ſpinal nerves runs in its courſe to the common holes juſt now deſcribed.

The upper part of the body of the firſt bone reſembles the *vertebræ* of the loins; but the ſmall fifth bone is oblong tranſverſely, and hollow in the middle of its lower ſurface.

The ſubſtance of the *os ſacrum* is very ſpongy, without any conſiderable ſolid external plates, and is lighter proportionably to its bulk than any other bone in the body; but is ſecured from injuries by the thick muſcles that cover it behind, and by the ſtrong ligamentous membranes that cloſely adhere to it. As this is one of the moſt remarkable inſtances of this ſort of defence afforded a ſoft weak bone, we may make the general obſervation. That, wherever we meet with ſuch a bone, one or other, or both theſe defences are made uſe of; the firſt to ward off injuries, and the ſecond to keep the ſubſtance of the bone from yielding too eaſily.

This bone is articulated above to the laſt *vertebra* of the loins, in the manner that the *lumbar vertebræ* are joined; and therefore the ſame motions may be performed here.—The articulation of the lower part of the *os ſacrum* to the *os coccygis* ſeems well enough adapted for allowing conſiderable motion to this laſt bone, was it not much confined by ligaments. Laterally, the *os ſacrum* is joined

to

to the *ossa ilium* by an immoveable *synchondrosis*, or what almost deserves the name of a suture; for the cartilaginous crust on the surface of the bones is very thin, and both their surfaces are so scabrous and unequal, as to be indented into each other; which makes such a strong connection, that great force is required to separate them, after all the muscles and ligaments are cut.—Frequently the two bones grow together in old subjects.

The uses of the *os sacrum* are, to serve as the common base and support of the trunk of the body, to guard the nerves proceeding from the end of the spinal marrow, to defend the back part of the *pelvis*, and to afford sufficient origin to the muscles which move the trunk and thigh.

The bones that compose the *os sacrum* of infants, have their bodies separated from each other by a thick cartilage; and, in the same manner as the *true vertebræ*, each of them consists of a body and two lateral plates, connected together by cartilages; the ends of the plates seldom being contiguous behind.

OS COCCYGIS *, or *rump bone*, is that triangular chain of bones depending from the *os sacrum*; each bone becoming smaller as they descend, till the last ends almost in a point. The *os coccygis* is convex behind, and concave before; from which crooked pyramidal figure, which was thought to resemble a cuckow's beak, it has got its name.

This

* Ὀξυκόκκυγιον, ὄξυς, caudæ os, spondylium, os cuculi.

This bone conſiſts of four pieces in people of middle age:—In children, very near the whole of it is cartilage: In old ſubjects, all the bones are united, and become frequently one continued bone with the *os ſacrum*.

The higheſt of the four bones is the largeſt, with ſhoulders extended farther to each ſide than the end of the *os ſacrum*; which enlargement ſhould, in my opinion, ſerve as a diſtinguiſhing mark to fix the limits of either bone; and therefore ſhould take away all diſpute about reckoning the number of bones, of which one or other of theſe two parts of the *falſe vertebræ*, is compoſed; which diſpute muſt ſtill be kept up, ſo long as the numbering five or ſix bones in the *os ſacrum* depends upon the uncertain accident of this broad ſhouldered little bone being united to or ſeparated from it.—The upper ſurface of this bone is a little hollow.——From the back of that bulbous part called its *ſhoulders*, a proceſs often riſes up on each ſide, to join with the bifurcated ſpine of the fourth and fifth bones of the *os ſacrum*, to form the bony bridge mentioned in the deſcription of the *os ſacrum*.—Sometimes theſe ſhoulders are joined to the ſides of the fifth bone of the *os ſacrum*, to form the hole in each ſide common to theſe two bones, for the paſſage of the twenty ninth pair of ſpinal nerves.—Immediately below the ſhoulders of the *os coccygis*, a notch may be remarked in each ſide, where the thirtieth pair of the ſpinal nerves paſſes—The lower end of this bone is formed into a ſmall head, which very often is hollow in the middle.

The

The three lower bones gradually become ſmaller, and are ſpongy; but are ſtrengthened by a ſtrong ligament which covers and connects them.—Their ends, by which they are articulated, are formed in the ſame manner as thoſe of the firſt bone are.

Between each of theſe four bones of young ſubjects a cartilage is interpoſed; therefore their articulation is analogous to that of the bodies of the *vertebrae* of the neck: For, as has been above remarked, the lower end of the *os ſacrum*, and of each of the three ſuperior bones of the *os coccygis*, has a ſmall depreſſion in the middle; and the upper part of all the bones of the *os coccygis* is a little concave, and conſequently the interpoſed cartilages are thickeſt in the middle, to fill up both cavities; by which they connect the bones more firmly.—When the cartilages oſſify, the upper end of each bone is formed into a cavity, exactly adapted to the protuberant lower end of the bone immediately above.—From this ſort of articulation, it is evident, that, unleſs when theſe bones grow together, all of them are capable of motion; of which, the firſt and ſecond, eſpecially this laſt, enjoys the largeſt ſhare.

The lower end of the fourth bone terminates in a rough point, to which a cartilage is appended.

To the ſides of theſe bones of the *os coccygis*, the *coccygaei* muſcles (*a*), and part of the *levatores ani*, and of the *glutaei maximi*, are fixed.

The

(*a*) Douglas, Myograph. chap. 40.—Euſtach, tab. 36. No. 45. 20.

The ſubſtance of theſe bones is very ſpongy, and in children cartilaginous; there being only a part of the firſt bone oſſified in a new born infant.—Since therefore the *inteſtinum rectum* of children is not ſo firmly ſupported as it is in *adults*, this may be one reaſon why they are more ſubject to a *procidentia ani* than old people (*a*).

From the deſcription of this bone, we ſee how little it reſembles the *vertebrae*; ſince it ſeldom has proceſſes, never has any cavity for the *ſpinal* marrow, nor holes for the paſſage of nerves.—Its connection hinders it to be moved to either ſide; and its motion backwards and forwards is much confined: Yet, as its ligaments can be ſtretched by a conſiderable force, it is a great advantage in the excretion of the *fæces alvinae*, and much more in child-bearing, that this bone ſhould remain moveable; and the right management of it, in delivering women, may be of great benefit to them (*b*).——The mobility of the *os coccygis* diminiſhing as people advance in age, eſpecially when its ligaments and cartilages have not been kept flexible by being ſtretched, is probably one reaſon why the women, who are old maids before they marry, have generally hard labour in child bed.

The *coccygis* ſerves to ſuſtain the *inteſtinum rectum*; and, in order to perform this office more effectually, it is made to turn with a curve

(*a*) Spigel. de humani corp. fabric. lib. 2. chap. 22.—Paaw, de oſſib. par. 2. cap. 3.

(*b*) Paaw, ibid.——Deventer, Operat. chirurg. cap. 27.

curve forwards; by which alſo the bone itſelf, as well as the muſcles and teguments, is preſerved from any injury, when we ſit with our body reclined back.

The ſecond part of the trunk of the ſkeleton, the *PELVIS*, is the cylindical cavity at the lower part of the *abdomen*, formed by the *os ſacrum*, *os coccygis*, and *oſſa innominata*; which laſt therefore fall now in courſe to be examined.

Though the name of *OSSA INNOMINATA** contributes nothing to the knowledge of their ſituation, ſtructure, or office; yet they have been ſo long and univerſally known by it, that there is no occaſion for changing it.———They are two large broad bones, which form the fore-part and ſides of the *pelvis*, and the lower part of the ſides of the *abdomen*.—In children each of theſe bones is evidently divided into three; which are afterwards ſo intimately united, that ſcarce the leaſt mark of their former ſeparation remains: This notwithſtanding, they are deſcribed as conſiſting each of three bones, to wit, the *os ilium*, *iſchium*, and *pubis*; which I ſhall firſt deſcribe ſeparately, and then ſhall conſider what is common to any two of them, or to all the three.

OS ILIUM†, or *haunch-bone*, is ſituated higheſt of the three, and reaches as far down as one third of the great cavity into which the head of the thigh bone is received.

The

* Σκελέων, προσφύσεις, ſacro conjuncta.

† Λαγόνων, κενεων, ſcaphium, lumbare; clunium, clavium, anchas.

The external ſide of this bone is unequally convex, and is called its *dorſum*;—the internal concave ſurface is by ſome (but improperly) named its *coſta*.—The ſemicircular edge at the higheſt part of this bone, which is tipped with a cartilage in the recent ſubject, is named the *ſpine*, into which the external or deſcending oblique muſcle of the *abdomen* is inſerted; and from it the internal aſcending oblique and the tranſverſe muſcles of the belly, with the *glutaeus maximus*, *quadratus lumborum*, and *latiſſimus dorſi*, have their origin. Some *(a)* are of opinion, that it is only the tendinous cruſt of all theſe muſcles, and not a cartilage, as commonly alledged, that covers this bony edge.——The ends of the ſpine are more prominent than the ſurface of the bone below them; therefore are reckoned proceſſes.——From the anterior ſpinal proceſſes, the *ſartorius* and *faſcialis* muſcles have their riſe, and the outer end of the doubled tendon of the external oblique muſcle of the *abdomen*, commonly called *Fallopius*'s or *Poupart*'s ligament, is fixed to it.——The inſide of the poſterior ſpinal proceſs, and of part of the ſpine forward from that, is made flat and rough where the *ſacro lumbalis* and *longiſſimus dorſi* riſe; and to its outſide ligaments, extended to the *os ſacrum* and tranſverſe proceſſes of the fifth and fourth *vertebræ* of the loins, are fixed *(b)*.—Below the anterior ſpinal proceſs another protuberance

(a) Winſlow, Expoſition anatomique du corps humain, traité, des os frais, § 96.

(b) Weitbrecht, Syndeſmolog. ſect. 4. § 39. 40. 46. 47.

tuberance ſtands out, which, by its ſituation, may be diſtinguiſhed from the former, by adding the epithet of *inferior*, where the *muſculus rectus tibiae* has its origin (*a*).—Betwixt theſe two anterior proceſſes the bone is hollowed where the beginning of the *ſartorius* muſcle is lodged.—Below the poſterior ſpinal proceſs, a ſecond protuberance of the edge of this bone is in like manner obſervable, which is cloſely applied to the *os ſacrum*.—Under this laſt proceſs a conſiderable large niche is obſervable in the *os ilium*; between the ſides of which and the ſtrong ligament that is ſtretched over from the *os ſacrum* to the ſharp pointed proceſs of the *os iſchium* of the recent ſubject, a large hole is formed, through which the *muſculus-pyriformis*, the great ſciatic nerve, and the poſterior crural veſſels paſs, and are protected from compreſſion.

The external broad ſide or *dorſum* of the *os ilium* is a little hollow towards the forepart; farther back it is as much raiſed; then is conſiderably concave; and, laſtly, it is convex. Theſe inequalities are occaſioned by the actions of the muſcles that are ſituated on this ſurface.—From behind the uppermoſt of the two anterior ſpinal proceſſes, in ſuch bones as are ſtrongly marked by the muſcles, a ſemicircular ridge is extended to the hollow paſſage of the ſciatic nerve. Between the ſpine and this ridge, the *glutæus medius* takes its riſe. Immediately from above the loweſt of the anterior ſpinal proceſſes, a ſecond ridge is

(*a*) Baker, Curſ. oſteolog. demonſtr. 3.

is ſtretched to the niche. Between this and the former ridge, the *glutæus minimus* has its origin.—On the outſide of the poſterior ſpinal proceſſes, the *dorſum* of the *os ilium* is flat and rough, where part of the *muſculus glutæus maximus* and *pyriformis* riſes.——The loweſt part of this bone is the thickeſt, and is formed into a large cavity with high brims, to aſſiſt in compoſing the great *acetabulum*; which ſhall be conſidered, after all the three bones that conſtitute the *os innominatum* are deſcribed.

The internal ſurface of the *os ilium* is concave in its broadeſt fore-part, where the internal iliac muſcle has its origin, and ſome ſhare of the *inteſtinum ilium* and *colon* is lodged.——From this large hollow, a ſmall ſinuoſity is continued obliquely forwards, at the inſide of the anterior inferior ſpinal proceſs, where part of the *pſoas* and *iliacus* muſcles, with the crural veſſels and nerves, paſs.—The large concavity is bounded below by a ſharp ridge, which runs from behind forwards; and, being continued with ſuch another ridge of the *os pubis*, forms a line of partition between the *abdomen* and *pelvis*.——Into this ridge the broad tendon of the *pſoas parvus* is inſerted.

All the internal ſurface of the *os ilium*, behind this ridge, is very unequal: For the upper part is flat, but ſpongy, where the *ſacrolumbalis* and *longiſſimus dorſi* riſe.——Lower down, there is a tranſverſe ridge from which ligaments go out to the *os ſacrum*.—Immediately below this ridge, the rough unequal cavities.

vities and prominences are placed, which are exactly adapted to thoſe deſcribed on the ſide of the *os ſacrum*.—In the ſame manner, the upper part of this rough ſurface is porous, for the firmer adheſion of the ligamentous cellular ſubſtance; while the lower part is more ſolid, and covered with a thin cartilaginous ſkin, for its immoveable articulation with the *os ſacrum*.——From all the circumference of this large unequal ſurface, ligaments are extended to the *os ſacrum*, to ſecure more firmly the conjunction of theſe bones.

The paſſages of the medullary veſſels are very conſpicuous, both in the *dorſum* and *coſta* of many *oſſa ilium*; but in others they are inconſiderable.

The poſterior and lower parts of theſe bones, are thick; but they are generally exceeding thin and compact at their middle, where they are expoſed to the actions of the *muſculi glutæi* and *iliacus internus*, and to the preſſure of the bowels contained in the belly.—The ſubſtance of the *oſſa ilium* is moſtly cellular, except a thin external table.

In a ripe child, the ſpine of the *os ilium* is cartilaginous, and is afterwards joined to the bone in form of an *epiphyſe*.——The large lower end of this bone is not compleatly oſſified.

*OS ISCHIUM** or hip bone, is of a middle bulk between the two other parts of the *os innominatum*, is ſituated loweſt of the three, and is of a very irregular figure.—Its extent

* Coxæ, coxendicis, pixis.

tent might be marked by an horizontal line drawn near through the middle of the *acetabulum*; for the upper bulbous part of this bone forms ſome leſs than the lower half of that great cavity, and the ſmall leg of it riſes to much the ſame height on the other ſide of the great hole common to this bone and the *os pubis*.

From the upper thick part of the *os iſchium*, a ſharp proceſs, called by ſome *ſpinous*, ſtands out backwards, from which chiefly the *muſculus coccygaeus* and *ſuperior gemellus*, and part of the *levator ani*, riſe; and the anterior or internal *ſacroſciatic* ligament is fixed to it.—Between the upper part of this ligament and the bones, it was formerly obſerved that the *pyriform* muſcle, the poſterior crural veſſels, and the ſciatic nerve, paſs out of the *pelvis*.—Immediately below this proceſs, a ſinuoſity is formed for the tendon of the *muſculus obturator internus*.—In a recent ſubject, this part of the bone, which ſerves as a pully on which the *obturator* muſcle plays, is covered with a ligamentous cartilage, that, by two or three ſmall ridges, points out the interſtices of the fibres in the tendon of this muſcle.——The outer ſurface of the bone at the root of this ſpinous proceſs is made hollow by the *pyriformis* or *iliacus externus* muſcle.

Below the ſinuoſity for the *obturator* muſcle, is the great knob or *tuberoſity*, covered with cartilage or tendon (*a*).——The upper part of the tuberoſity gives riſe to the inferior

(*a*) Winſlow, Expoſit. anat. des os frais, § 96.

inferior *gemellus* muſcle.—To a ridge at the inſide of this, the external or poſterior *ſacroſciatic* ligament is ſo fixed that between it, the internal ligament, and the ſinuoſity of the *os iſchium*, a paſſage is left for the internal *obturator* muſcle.——The upper thick ſmooth part of the *tuber*, called by ſome its *dorſum*, has two oblique impreſſions on it. The inner one gives origin to the long head of the *biceps flexor tibiæ* and *ſeminervoſus* muſcles, and the *ſemimembranoſus* riſes from the exterior one, which reaches higher and nearer the *acetabulum* than the other.—The lower, thinner, more ſcabrous part of the knob which bends forwards, is alſo marked with two flat ſurfaces, whereof the internal is what we lean upon in ſitting, and the external gives riſe to the largeſt head of the *triceps adductor femoris*.——Between the external margin of the tuberoſity and the great hole of the *os innominatum*, there is frequently an obtuſe ridge extended down from the *acetabulum*, which gives origin to the *quadratus femoris*. —As the *tuber* advances forwards, it becomes ſmaller, and is rough, for the origin of the *muſculus tranſverſalis* and *erector penis*.—— The ſmall leg of it, which mounts upwards to join the *os pubis*, is rough and prominent at its edge, where the two lower heads of the *triceps* or *quadriceps adductor femoris* take their riſe.

The upper and back part of the *os iſchium* is broad and thick; but its lower and fore-part is narrower and thinner.——Its ſubſtance is of the ſtructure common to broad bones.

The

The *os ilium* and *pubis* of the ſame ſide are the only bones which are contiguous to the *os iſchium*.

The part of the *os iſchium* which forms the *acetabulum*, the ſpinous proceſs, the great *tuber*, and the recurved leg, are all cartilaginous at birth.—The *tuber*, with part of the leg or proceſs above it, becomes an epiphyſe before this bone is fully formed.

The *OS PUBIS**, or *ſhare bone*, is the leaſt of the three parts of the *os innominatum*, and is placed at the upper fore-part of it.—The thick largeſt part of this bone is employed in forming the *acetabulum*; from which becoming much ſmaller, it is ſtretched inwards to its fellow of the other ſide, where again it grows larger, and ſends a ſmall branch downwards to join the end of the ſmall leg of the *os iſchium*.———The upper fore part of each *os pubis* is tuberous and rough where the *muſculus rectus* and *pyramidalis* are inſerted. ——From this a ridge is extended along the upper edge of the bone, in a continued line with ſuch another of the *os ilium*, which divides the *abdomen* and *pelvis*. The ligament of *Fallopius* is fixed to the internal end of this ridge, and the ſmooth hollow below it is made by the *pſoas* and *iliacus internus* muſcles paſſing with the anterior crural veſſels and nerves behind the ligament.———Some way below the former ridge, another is extended from the tuberous part of the *os pubis* downwards and outwards towards the *acetabulum*; between

* ἥβης, pectinis, penis, pudibundum, feneſtratum.

between theſe two ridges the bone is hollow and ſmooth, for lodging the head of the *pectineus* muſcle.—Immediately below, where the lower ridge is to take the turn downwards, a winding niche is made, which is comprehended in the great *foramen* of a ſkeleton, but is formed into a hole by a ſubtended ligament in the recent ſubject, for the paſſage of the poſterior crural nerve, an artery, and a vein.———The internal end of the *os pubis* is rough and unequal, for the firmer adheſion of the thick ligamentous cartilage that connects it to its fellow of the other ſide; ———The proceſs which goes down from that to the *os iſchium* is broad and rough before, where the *gracilis* and upper heads of the *triceps*, or rather *quadriceps adductor femoris* have their origin.

The ſubſtance of the *os pubis* is the ſame as of other broad bones.

Only a part of the large end of this bone is oſſified, and the whole leg is cartilaginous, in a child born at the full time.

Betwixt the *os iſchium* and *pubis* a very large irregular hole is left, which, from its reſemblance to a door or ſhield, has been called *thyroides*. This hole is all, except the niche for the poſterior crural nerve, filled up in a recent ſubject with a ſtrong ligamentous membrane, that adheres very firmly to its circumference. From this membrane chiefly the two *obturator* muſcles, external and internal, take their riſe.—The great deſign of this hole, beſides rendering the bone lighter, is to allow a ſtrong enough origin to the *obtura-*

tor

tor muſcles, and ſufficient ſpace for lodging their bellies, that there may be no danger of diſturbing the functions of the contained *viſcera* of the *pelvis* by the actions of the internal, nor of the external being bruiſed by the thigh bone, eſpecially by its leſſer *trochanter*, in the motions of the thigh inwards: Both which inconveniences muſt have happened, had the *oſſa innominata* been compleat here, and of ſufficient thickneſs and ſtrength to ſerve as the fixed point of theſe muſcles.—The bowels ſometimes make their way through the nitch for the veſſels, at the upper part of this *thyroid* hole, and this cauſes a *hernia* in this place (*a*).

In the external ſurface of the *oſſa innominata*, near the outſide of the great hole, a large deep cavity is formed by all the three bones conjunctly: For the *os pubis* conſtitutes about one fifth; the *os ilium* makes ſomething leſs than two fifths, and the *os iſchium* as much more than two fifths. The brims of this cavity are very high, and are ſtill much more enlarged by the ligamentous cartilage, with which they are tipped in a recent ſubject. From this form of the cavity it has been called *acetabulum*; and for a diſtinguiſhing character, the name of the bone that conſtitutes the largeſt ſhare of it is added; therefore *acetabulum oſſis iſchii* * is the name this cavity commonly bears.—Round the baſe

(*a*) Memoires de l'acad. de chirurgie, tom. 1. p. 709, &c.
* Coxæ, coxendicis.

of the *ſupercilia* the bone is rough and unequal, where the *capſular* ligament of the articulation is fixed.——The brims at the upper and back part of the *acetabulum* are much larger and higher than any where elſe; which is very neceſſary to prevent the head of the *femur* from ſlipping out of its cavity at this place, where the whole weight of the body bears upon it, and conſequently would otherwiſe be conſtantly in danger of thruſting it out. —As theſe brims are extended downwards and forwards, they become leſs; and at their internal lower part a breach is made in them; from the one ſide of which to the other, a ligament is placed in the recent ſubject; under which a large hole is left, which contains a fatty cellular ſubſtance and veſſels. The reaſon of which appearance has afforded matter of debate. To me it ſeems evidently contrived for allowing a larger motion to the thigh inwards: For if the bony brims had been here continued, the neck of the thigh bone muſt have ſtruck upon them when the thighs were brought acroſs each other; which, in a large ſtrong motion this way, would have endangered the neck of the one bone, or brim of the other. Then the veſſels which are diſtributed to the joint may ſafely enter at the ſinuoſity in the bottom of the breach; which being however larger than is neceſſary for that purpoſe, allows the large mucilaginous gland of the joint to eſcape below the ligament, when the head of the thigh bone is in hazard of preſſing too much upon it in the

motions

motions of the thigh outwards (*a*).—Beſides this difference in the height of the brims, the *acetabulum* is otherwiſe unequal: For the lower internal part of it is depreſſed below the cartilaginous ſurface of the upper part, and is not covered with cartilage; into the upper part of this particular depreſſion, where it is deepeſt and of a ſemilunar form, the ligament of the thigh bone, commonly, though improperly, called the round-one, is inſerted; while in its more ſuperficial lower part the large mucilaginous gland of this joint is lodged. The largeſt ſhare of this ſeparate depreſſion is formed in the *os iſchium*.

From what has been ſaid of the condition of the three bones compoſing this *acetabulum* in new born children, it muſt be evident, that a conſiderable part of this cavity is cartilaginous in them.

The *oſſa innominata* are joined at their back part to each ſide of the *os ſacrum* by a ſort of ſuture, with a very thin intervening cartilage, which ſerves as ſo much glue to cement theſe bones together; and ſtrong ligaments go from the circumference of this unequal ſurface, to connect them more firmly. The *oſſa innominata* are connected together at their fore-part by the ligamentous cartilage interpoſed between the two *oſſa pubis*.—Theſe bones can therefore have no motion in a natural ſtate, except what is common to the trunk of the body, or to the *os ſacrum*. But it has been diſputed, whether or not they looſen ſo much from each other, and from the *os ſacrum*, in child-birth, by the

(*a*) Petit, Memoires de l'acad. des ſciences, 1722.

flow of *mucus* to the *pelvis*, and by the throws of the labour, as that the *ossa pubis* recede from each other, and thereby allow the passage between the bones to be enlarged.—Several observations *(a)* shew that this relaxation sometimes happens: But those who had frequently opportunities of dissecting the bodies of women who died immediately after being delivered of children, teach us to beware of regarding this as the common effect of child-birth; for they found such a relaxation in very few of the bodies which they examined *(b)*.

Considering what great weight is supported in our erect posture, by the articulation of the *ossa innominata* with the *os sacrum*, there is great reason to think that if the conglutinated surfaces of these bones were once separated, (without which, the *ossa pubis* cannot shuffle on each other), the ligaments would be violently stretched, if not torn; from whence many disorders would arise *(c)*.

Each *os innominatum* affords a socket (the *acetabulum*) for the thigh bones to move in, and the trunk of the body rolls here so much on the heads of the thigh bones, as to allow the most conspicuous motions of the *trunk*, which are commonly thought to be performed by the bones of the spine.—This articulation is to be

(*a*) Bauchin. Theat. anat. lib. 1. cap. 49.—Spigel. Anat. lib. 2. cap. 24.—Riolan. Anthropogr. lib. 6. cap. 12.—Diemerbroeck, Anat. lib. 9 cap. 16.

(*b*) Hildan. Epist. cent. obs. 46.—Dionis. Sixieme demonst. des os.—Morgagn. Advers. 3. animad. 15.

(*c*) Ludov. in Ephem. German. dec. 1. ann. 3. obs. 255.

be more fully deſcribed after the *oſſa femoris* are examined.

The *pelvis* then has a large open above where it is continued with the *abdomen*, is ſtrongly fenced by bones on the ſides, back, and fore-part, and appears with a wide opening below, in the ſkeleton; but, in the recent ſubject, a conſiderable part of the opening is filled by the *ſacroſciatic* ligaments, *pyriform*, *internal obturator*, *levatores ani*, *gemini*, and *coccygæi* muſcles, which ſupport and protect the contained parts better than bones could have done; ſo that ſpace is only left at the loweſt part of it, for the large excretories, the *veſica urinaria*, *inteſtinum rectum*, and in females, the *uterus*, to diſcharge themſelves.

The *THORAX* *, or *cheſt*, which is the only part of the trunk of the body which we have not yet deſcribed, reaches from below the neck to the belly; and, by means of the bones that guard it, is formed into a large cavity: The figure of which is ſomewhat conoidal; but its upper ſmaller end is not finiſhed, being left open for the paſſage of the wind-pipe, gullet, and large blood veſſels; and its lower part, or baſe, has no bones, and is ſhorter before than behind; ſo that, to carry on our compariſon, it appears like an oblique ſection of the conoid. Beſides which we ought alſo to remark, that the lower part of this cavity is narrower than ſome way above (*a*); and that the middle of its back-part is conſiderably diminiſhed by the bones ſtanding forwards into it.

* Pectus, caſſum.

(*a*) Albin. de oſſib. § 169.

The bones which form the *thoræx* are the twelve dorſal *vertebræ* behind, the ribs on the ſides, and the *ſternum* before.

The *vertebræ* have already been deſcribed as part of the ſpine; and therefore are now to be paſſed.

The *RIBS*, or *coſtæ* *, (as if they were *cuſtodes*, or guards, to theſe principal organs of the animal machine, the heart and lungs), are the long crooked bones placed at the ſide of the cheſt, in an oblique direction downwards in reſpect of the back bone.——Their number is generally twelve on each ſide; though frequently eleven or thirteen have been found *(b)*—Sometimes the ribs are found preternaturally conjoined or divided *(c)*.

The ribs are all concave internally; where they are alſo made ſmooth by the action of the contained parts, which, on this account, are in no danger of being hurt by them; and they are convex externally, that they might reſiſt that part of the preſſure of the atmoſphere, which is not balanced by the air within the lungs, during *inſpiration*.—The ends of the ribs next the *vertebræ* are rounder than they are after theſe bones have advanced forwards, when they become flatter and broader, and have an upper and lower edge, each of which is made rough by the action of the *intercoſtal* muſcles, inſerted

* Πλευραι, περιςέρνα, σπαδαι.

(b) Riolac. Comment. de oſſibus, cap. 19.—Ma chetti. cap. 9. Cowper Explicat. tab. 93. and 94.—Mo gagn. Adverſ. anat.

(c) Sue Trad. d'oſteolog. p. 141.

inſerted into them. Theſe muſcles, being all of nearly equal force, and equally ſtretched in the interſtices of the ribs, prevent the broken ends of theſe bones in a fracture from being removed far out of their natural place, to interrupt the motion of the vital organs.—The upper edge of the ribs is more obtuſe and rounder than the lower, which is depreſſed on its internal ſide by a long *foſſa*, for lodging the intercoſtal veſſels and nerves; on each ſide of which there is a ridge, to which the intercoſtal muſcles are fixed. The *foſſa* is not obſervable however at either end of the ribs; for at the poſterior or root, the veſſels have not yet reached the ribs; and, at the fore end, they are ſplit away into branches, to ſerve the parts between the ribs: Which plainly teaches ſurgeons one reaſon of the greater ſafety of performing the operation of the *empyema* towards the ſides of the *thorax*, than either near the back or the breaſt.

At the poſterior end * of each rib, a little head is formed, which is divided by a middle ridge into two plain or hollow ſurfaces; the loweſt of which is the broadeſt and deepeſt in moſt of them. The two plains are joined to the bodies of two different *vertebræ*, and the ridge forces itſelf into the intervening cartilage.—A little way from this head, we find, on the external ſurface, a ſmall cavity, where mucilaginous glands are lodged; and round the head, the bone appears ſpongy, where the cap-

* Κώπιον, remulus.

ſular ligament of the articulation is fixed.—Immediately beyond this a flatted tubercle riſes, with a ſmall cavity at, and roughneſs about its root, for the articulation of the rib with the tranſverſe proceſs of the loweſt of the two *vertebræ*, with the bodies of which the head of the rib is joined.—Advancing further on this external ſurface, we obſerve in moſt of the ribs another ſmaller tubercle, into which ligaments which connect the ribs to each other, and to the tranſverſe proceſſes of the *vertebræ* and portions of the *longiſſimus dorſi*, are inſerted.—Beyond this the ribs are made flat by the *ſacro-lumbalis* muſcle, which is inſerted into the part of this flat ſurface fartheſt from the ſpine, where each rib makes a conſiderable curve, called by ſome its *angle*.——Then the rib begins to turn broad, and continues ſo to its anterior end *, which is hollow and ſpongy, for the reception of, and firm coalition with the cartilage that runs thence to be inſerted into the *ſternum*, or to be joined with ſome other cartilage.—In adults, generally the cavity at this end of the ribs is ſmooth and poliſhed on its ſurface; by which the articulation of the cartilage with it has the appearance of being deſigned for motion; but it has none.

The ſubſtance of the ribs is ſpongy, cellular, and only covered with a very thin external lamellated ſurface, which increaſes in thickneſs and ſtrength as it approaches the *vertebræ*.

To the fore-end of each rib a long broad and ſtrong cartilage is fixed, and reaches thence to

* Πλατη, palmula.

to the *ſternum*, or is joined to the cartilage of the next rib. This courſe, however, is not in a ſtreight line with the rib; for generally the cartilages make a conſiderable curve, the concave part of which is upwards; therefore, at their inſertion into the *ſternum*, they make an obtuſe angle above, and an acute one below.—Theſe cartilages are of ſuch a length as never to allow the ribs to come to a right angle with the ſpine; but they keep them ſituated ſo obliquely, as to make an angle very conſiderably obtuſe above, till a force exceeding the elaſticity of the cartilages is applied.—Theſe cartilages, as all others, are firmer and harder internally, than they are on their external ſurface; and ſometimes, in old people, all their middle ſubſtance becomes bony, while a thin cartilaginous *lamella* appears externally *(a)*. The oſſification however begins frequently at the external ſurface.—The greateſt alternate motions of the cartilages being made at their great curvature, that part remains frequently cartilaginous, after all the reſt is oſſified *(b)*.

The ribs then are articulated at each end, of which the one behind is doubly joined to the *vertebræ*; for the head is received into the cavities of two bodies of the *vertebræ*, and the larger tubercle is received into the depreſſion in the tranſverſe proceſs of the lower *vertebra*. ——When one examines the double articulation, he muſt immediately ſee, that no other motion can here be allowed than upwards and downwards; ſince the tranſverſe proceſs hinders

(*a*) Veſal. lib. 2. cap. 19.
(*b*) Havers. Oſteolog. nov. diſc. 5. p. 289.

the rib to be thruſt back; the reſiſtance on the other ſide of the *ſternum* prevents the ribs coming forward; and each of the two joints, with the other parts attached, oppoſe its turning round. But then it is likewiſe as evident, that even the motion upwards and downwards can be but ſmall in any one rib at the articulation itſelf. But as the ribs advance forwards, the diſtance from their center of motion increaſing, the motion muſt be larger; and it would be very conſpicuous at their anterior ends, were not they reſiſted there by the cartilages, which yield ſo little, that the principal motion is performed by the middle part of the ribs, which turns outwards and upwards, and occaſions the twiſt remarkable in the long ribs at the place near their fore-end where they are moſt reſiſted (*a*).

Hitherto I have laid down the ſtructure and connection which moſt of the ribs enjoy, as belonging to all of them; but muſt now conſider the ſpecialities wherein any of them differ from the general deſcription given, or from each other.

In viewing the ribs from above downwards, their figure is ſtill ſtreighter; the uppermoſt being the moſt crooked of any.—Their obliquity in reſpect of the ſpine increaſes as they deſcend; ſo that though their diſtances from each other is very little different at their back-part, yet at their fore-ends the diſtances between the lower ones muſt increaſe.—In conſequence too of this increaſed obliquity of the lower ribs, each

(*a*) Winſlow, Memoires de l'acad. des ſciences, 1720.

each of their cartilages makes a greater curve in its progreſs from the rib towards the *ſternum*; and the tubercles, that are articulated to the tranſverſe proceſſes of the *vertebræ*, have their ſmooth ſurfaces gradually facing more upwards.——The ribs becoming thus more oblique, while the *ſternum* advances forwards in its deſcent, makes the diſtance between the *ſternum* and the anterior end of the lower ribs greater than between the *ſternum* and the ribs above; conſequently the cartilages of thoſe ribs that are joined to the breaſt-bones are longer in the lower than in the higher ones.—Theſe cartilages are placed nearer to each other as the ribs deſcend, which occaſions the curvature of the cartilages to be greater.

The length of the ribs increaſes from the firſt and uppermoſt rib, as far down as the ſeventh; and from that to the twelfth, as gradually diminiſhes.——The ſuperior of the two plain, or rather hollow ſurfaces, by which the ribs are articulated to the bodies of the *vertebræ*, gradually increaſes from the firſt to the fourth rib, and is diminiſhed after that in each lower rib.———The diſtance of their angles from the heads always increaſes as they deſcend to the ninth, becauſe of the greater breadth of the *ſacro-lumbalis* muſcle (*a*).

The ribs are commonly divided into *true* and *falſe*.

The *true* † *coſtae* are the ſeven upper ones of each ſide, whoſe cartilages are all gradually

(*a*) Winſlow. Expoſition antomique des os ſecs, § 623.

† Γνησαι, Germanæ, legitimæ.

ally longer as the ribs descend, and are joined to the breast-bone; so that being pressed constantly between two bones, they are flatted at both ends, and are thicker, harder, and more liable to ossify, than the other cartilages, that are not subject to so much pressure. These ribs include the heart and lungs; and therefore are the proper or true *custodes* of life.

The five inferior ribs of each side are the *false* or *BASTARD* †, whose cartilages do not reach to the *sternum*; and therefore, wanting the resistance at their fore-part, they are then pointed; and, on this account, having less pressure, their substance is softer. ——The cartilages of these *false ribs* are shorter as the ribs descend.——To all these five ribs the circular edge of the *diaphragm* is connected; and its fibres, instead of being stretched immediately transversely, and so running perpendicular to the ribs, are pressed so as to be often, especially in exspiration, parallel to the plane in which the ribs lie: Nay, one may judge by the attachments which these fibres have so frequently to the sides of the *thorax*, a considerable way above where their extremities are inserted into the ribs, and by the situation of the *viscera*, always to be observed in a dead subject laid supine, that there is constantly a large concavity formed on each side by the *diaphragm* within these bastard ribs, in which the stomach, liver, spleen, *&c.* are contained; which, being only reckoned

† Μαλθακαι, χονδροδεις, ἀκανθαι, κλῆνες, ῥόαι, adulterinæ, spuriæ, illegitimæ.

reckoned among the *viſcera naturalia*, have occaſioned the name of *baſtard cuſtodes* to theſe bones.

Hence in ſimple fractures of the falſe ribs, without fever, the ſtomach ought to be kept moderately filled with food, leſt the pendulous ribs falling inwards, ſhould thereby increaſe the pain, cough, &c. (*a*)——Hence likewiſe we may learn how to judge better of the ſeat of ſeveral diſeaſes, and to do the operation of the *empyema*, and ſome others, with more ſafety than we can do, if we follow the common directions.

The eight upper ribs were formerly (*b*) claſſed into pairs, with particular names to each two, to wit, the *crooked*, the *ſolid*, the *pectoral*, the *twiſted*: But theſe names are of ſo little uſe, that they are now generally neglected.

The *firſt* rib of each ſide is ſo ſituated, that the flat ſides are above and below, while one edge is placed inwards, and the other outwards, or nearly ſo; therefore ſufficient ſpace is left above it for the ſubclavian veſſels and muſcle; and the broad concave ſurface is oppoſed to the lungs: But then, in conſequence of this ſituation, the channel for the intercoſtal veſſels is not to be found, and the edges are differently formed from all the other, except the ſecond; the lower one being rounded, and the other ſharp.——The head of this rib is not divided into two plain ſurfaces by a middle

(*a*) Hippocrat. de articulo, § 51.—Pare, lib. 15. cap. 11.
(*b*) Laurent. Hiſt. anat. lib. 2. cap. 29.——Paaw, de oſſibus, part. 3, cap. 2.

a middle ridge, becauſe it is only articulated with the firſt *vertebra* of the *thorax*.——Its cartilage is oſſified in adults, and is united to the *ſternum* at right angles.———Frequently this firſt rib has a ridge riſing near the middle of its poſterior edge, where one of the heads of the *ſcalenus* muſcle riſes.——Farther forward it is flatted, or ſometimes depreſſed by the clavicle.

The fifth, ſixth, and ſeventh, or rather the ſixth, ſeventh, eighth, and ſometimes the fifth, ſixth, ſeventh, eighth, ninth ribs, have their cartilages at leaſt contiguous; and frequently they are joined to each other by croſs cartilages; and moſt commonly the cartilages of the eighth, ninth, tenth, are connected to the former and to each other by firm ligaments.

The *eleventh*, and ſometimes the *tenth* rib, has no tubercle for its articulation with the tranſverſe proceſs of the *vertebra*, to which it is only looſely fixed by ligaments.———The *foſſa* in its lower edge is not ſo deep as in the upper ribs, becauſe the veſſels run more towards the interſtice between the ribs.——Its fore-end is ſmaller than its body, and its ſhort ſmall cartilage is but looſely connected to the cartilage of the rib above.

The *twelfth* rib is the ſhorteſt and ſtraighteſt.——Its head is only articulated with the laſt *vertebra* of the *thorax*; therefore is not divided into two ſurfaces.——This rib is not joined to the tranſverſe proceſs of the *vertebra*, and therefore has no tubercle, being often

ten pulled neceſſarily inwards by the diaphragm, which an articulation with the tranſverſe proceſs would not have allowed.——The *foſſa* is not found at its under edge, becauſe the veſſels run below it.——The fore-part of this rib is ſmaller than its middle, and has only a very ſmall-pointed cartilage fixed to it.——To its whole internal ſide the diaphragm is connected.

The motions and uſes of the ribs ſhall be more particularly treated of after the deſcription of the *ſternum*.

The heads and tubercles of the ribs of a new-born child have cartilages on them; part of which becomes afterwards thin epiphyſes.——The bodies of the ribs incroach gradually after birth upon the cartilages; ſo that the latter are proportionally ſhorter, when compared to the ribs, in adults, than in children.

Here I cannot help remarking the wiſe providence of our Creator, in preſerving us from periſhing as ſoon as we come into the world. The end of the bones of the limbs remain in a cartilaginous ſtate after birth, and are many years before they are entirely united to the main body of their ſeveral bones; whereas the condyles of the occipital bone, and of the lower jaw, are true original proceſſes, and oſſified before birth, and the heads and tubercles of the ribs are nearly in the ſame condition; and therefore the weight of the large head is firmly ſupported; the actions of ſucking, ſwallowing, reſpiration, &c. which are indiſpenſably neceſſary for us as ſoon as we come

come into the world, are performed without danger of ſeparating the parts of the bones that are moſt preſſed on in theſe motions: Whereas, had theſe proceſſes of the head, jaw, and ribs, been epiphyſes at birth, children muſt have been expoſed to danger of dying by ſuch a ſeparation; the immediate conſequences of which would be the compreſſion of the beginning of the *ſpinal* marrow, or want of food, or a ſtop put to reſpiration.

The *STERNUM* *, or *breaſt-bone*, is the broad flat bone, or pile of bones, at the fore-part of the *thorax*.———The number of bones which this ſhould be divided into, has occaſioned debates among anatomiſts, who have conſidered it in ſubjects of different ages.———In adults of a middle age, it is compoſed of three bones, which eaſily ſeparate after the cartilages connecting them are deſtroyed. Frequently the two lower bones are found intimately united; and very often in old people, the *ſternum* is a continued bony ſubſtance from one end to the other; though we ſtill obſerve two, ſometimes three tranſverſe lines on its ſurface; which are marks of the former diviſions.

When we conſider the *ſternum* as one bone, we find it broadeſt and thickeſt above, and becoming ſmaller as it deſcends. The internal ſurface of this bone is ſomewhat hollowed for enlarging the *thorax*; but the convexity on the external ſurface is not ſo conſpicuous, becauſe the ſides are preſſed outwards by

* Στῆθος, os pectoris, enſiforme, ſcutum cordis.

by the true ribs; the round heads of whoſe cartilages are received into ſeven ſmooth pits, formed into each ſide of the *ſternum*, and are kept firm there by ſtrong ligaments, which on the external ſurface have a particular radiated texture (*a*)—Frequently the cartilaginous fibres thruſt themſelves into the bony ſubſtance of the *ſternum*, and are joined by a ſort of ſuture.—The pits at the upper part of the *ſternum* are at the greateſt diſtance one from another, and, as they deſcend, are nearer; ſo that the two loweſt are contiguous.

The ſubſtance of the breaſt-bone is cellular, with a very thin external plate, eſpecially on its internal ſurface, where we may frequently obſerve a cartilaginous cruſt ſpread over it (*b*). On both ſurfaces, however, a ſtrong ligamentous membrane is cloſely braced; and the cells of this bone are ſo ſmall, that a conſiderable quantity of oſſeous fibres muſt be employed in the compoſition of it: Whence, with the defence which the muſcles give it, and the moveable ſupport it has from the cartilages, it is ſufficiently ſecured from being broken; for it is ſtrong by its quantity of bone; its parts are kept together by ligaments; and it yields enough to elude conſiderably the violence offered (*c*).

So far may be ſaid of this bone in general; but the three bones, of which, according to the

(*a*) Ruyſch. Catalog. rar. fig. 9.
(*b*) Jac. Sylv. in Galen de oſſibus, cap. 12.
(*c*) Senac. in Memoires de l'acad. des ſciences, 1724.

the common account, it is compoſed in adults, are each to be examined.

The *firſt*, all agree, is ſomewhat of the figure of a heart, as it is commonly painted; only it does not terminate in a ſharp point.—This is the uppermoſt thickeſt part of the *ſternum*.

The upper middle-part of this firſt bone, where it is thickeſt, is hollowed, to make place for the *trachea arteria*; though this cavity * is principally formed by the bone being raiſed on each ſide of it, partly by the clavicles thruſting it inwards, and partly by the *ſterno-maſtoidei* muſcles pulling it upwards.——On the outſide of each tubercle, there is an oblong cavity, that, in viewing it tranſverſely from before backwards, appears a little convex: Into theſe *glenæ* the ends of the clavicles are received.—Immediately below theſe, the ſides of this bone begin to turn thinner; and in each a ſuperficial cavity or a rough ſurface is to be ſeen, where the firſt ribs are received or joined to the *ſternum*.——In the ſide of the under end of this firſt bone, the half of the pit for the ſecond rib on each ſide is formed.——The upper part of the ſurface behind is covered with a ſtrong ligament, which ſecures the clavicles; and is afterwards to be more particularly taken notice of.

The ſecond or middle diviſion of this bone, is much longer, narrower, and thinner, than the firſt; but, excepting that it is a little narrower

* Σφαγὴ, jugulum, furcula ſuperior.

rower above than below, it is nearly equal all over in its dimenſions of breadth or thickneſs.———In the ſides of it are compleat pits for the third, fourth, fifth, and ſixth ribs, and an half of the pits for the ſecond and ſeventh. The lines, which are marks of the former diviſion of this bone, being extended from the middle of the pits of one ſide to the middle of the correſponding pits of the other ſide.——Near its middle an unoſſified part of the bone is ſometimes found, which, freed of the ligamentous membrane or cartilage that fills it, is deſcribed as a hole; and in this place, for the moſt part, we may obſerve a tranſverſe line, which has made authors divide this bone into two.—When the cartilage between this and the firſt bone is not oſſified, a manifeſt motion of this upon the firſt may be obſerved in reſpiration or in raiſing the *ſternum*, by pulling the ribs upwards or diſtending the lungs with air in a recent ſubject.

The third bone is much leſs than the other two, and has only one half of the pit for the ſeventh rib formed in it; wherefore it might be reckoned only an *appendix* of the *ſternum*. ——In young ſubjects it is always cartilagirous, and is better known by the name of *cartilago xiphoides* or *enſiformis* *, than any other; though the ancients often called the whole *ſternum enſiforme*, comparing the two firſt bones to the handle

* Clypealis, gladialis, mucronata, malum granatum, ſcutum ſtomachi, epiglottalis, cultralis, medium furculæ inferioris, ſcutiformis, enſiculata.

handle and this *appendix* to the blade of a ſword.—The third bone is ſeldom of the ſame figure, magnitude, or ſituation in any two ſubjects; for ſometimes it is a plain triangular bone, with one of the angles below, and perpendicular to the middle of the upper ſide, by which it is connected to the ſecond bone.——In other people the point is turned to one ſide, or obliquely forwards or backwards.—Frequently it is all nearly of an equal breadth, and in ſeveral ſubjects it is bifurcated; whence ſome writers give it the name of *furcella* or *furcula inferior*; or elſe it is unoſſified, in the middle.—In the greateſt number of adults it is oſſified, and tipped with a cartilage; in ſome one half of it is cartilaginous, and in others it is all in a cartilaginous ſtate. Generally ſeveral oblique ligaments fixed at one end to the cartilages of the ribs, and by the other to the outer ſurface of the *xiphoid* bone, connect it firmly to thoſe cartilages (*a*).

So many different ways this ſmall bone may be formed, without any inconvenience: But then ſome of theſe poſitions may be ſo directed, as to bring on a great train of ill conſequences; particularly, when the lower end is oſſified, and is too much turned outwards or inwards (*b*), or when the conjunction

(*a*) Weitbrecht. Syndeſmolog. p. 121.

(*b*) Rolfinc. Differt. anat. lib. 2. cap. 41.——Paaw. de oſſib. part. 1. cap. 3. & part 3. cap. 3.—Codronchi de prolapſu cartilagin. mucronat.

tien of this *appendix* with the ſecond bone is too weak (*a*).

The *ſternum* is joined by cartilages to the ſeven upper ribs, unleſs when the firſt coaleſces with it in an intimate union of ſubſtance; and its unequal cavity on each ſide of its upper end is fitted for the ends of the clavicles.

The *ſternum* moſt frequently has four round ſmall bones, ſurrounded with cartilage, in children born at the full time; the uppermoſt of theſe, which is the firſt bone, being the largeſt.——Two or three other very ſmall bony points are likewiſe to be ſeen in ſeveral children. ——The number of bones increaſes for ſome years, and then diminiſhes, but uncertainly, till they are at laſt united into thoſe above deſcribed of an adult.

The uſes of this bone are, to afford origin and inſertion to ſeveral muſcles; to ſuſtain the *mediaſtinum*, to defend the vital organs, the heart and lungs, at the fore-part: and, laſtly, by ſerving as a moveable *fulcrum* of the ribs, to aſſiſt conſiderably in reſpiration: Which action, ſo far it depends on the motion of the bones, we are now at liberty to explain.

When the ribs that are connected by their cartilages to the *ſternum*, or to the cartilages of the true ribs, are acted upon by the intercoſtal muſcles, they muſt all be pulled from the oblique

(*a*) Paaw. ibid.—Borrich. act. Haſn. vol. 5. ob. 79.—Bonet. Sepulchret. anat. tom. 2. lib. 3. § 5. Append. ad obſ. 8. et ibid. § 7. obſ. 19.

oblique poſition which their cartilages kept them in, nearer to the right angles with the *vertebrae* and *ſternum*, becauſe the firſt or uppermoſt rib is by much the moſt fixed of any; and the cartilages making a great reſiſtance to raiſing the anterior ends of the ribs, their large arched middle parts turn outwards as well as upwards.——The *ſternum*, preſſed ſtrongly on both ſides by the cartilages of the ribs, is puſhed forwards, and that at its ſeveral parts, in proportion to the length and motion of its ſupporters, the ribs; that is, moſt at its lower end.——The *ſternum* and the cartilages, thus raiſed forwards, muſt draw the *diaphragm* connected to them; conſequently ſo far ſtretch it, and bring it nearer to a plane.——The power that raiſes this bone and the cartilages, fixes them ſufficiently to make them reſiſt the action of the *diaphragm*, whoſe fibres contract at the ſame time, and thruſt the *viſcera* of the *abdomen* downwards.——The arched part of the ribs being thus moved outwards, their anterior ends and the *ſternum* being advanced forwards, and the diaphragm being brought nearer to a plain ſurface, inſtead of being greatly convex on each ſide within each cavity of the *thorax*, it is evident how conſiderably the cavity, of which the nine or ten upper ribs are the ſides, muſt be widened, and made deeper and longer.——While this is doing in the upper ribs, the lower ones, whoſe cartilages are not joined to the *ſternum* or to other cartilages, move very differently, though they conſpire to the ſame intention, the enlargement of the *thorax*: For having no fixed point to which their anterior

anterior ends are faſtened, and the *diaphragm* being inſerted into them at the place where it runs pretty ſtreight upwards from its origin at the *vertebræ*, theſe ribs are drawn downwards by this ſtrong muſcle, and by the muſcles of the *abdomen*, which, at this time, are reſiſting the ſtretching force of the bowels; while the intercoſtal muſcles are pulling them in the contrary direction, to wit, upwards: The effect therefore of either of theſe powers, which are antagoniſts to each other, is very little, as to moving the ribs either up or down; but the muſcles of the *abdomen*, puſhing at this time outwards by the *viſcera*, carry theſe ribs along with them.——Thus the *thorax* is not only not allowed to be ſhortened, but is really widened at its lower part, to aſſiſt in making ſufficient ſpace for the due diſtenſion of the lungs.

As ſoon as the action of theſe ſeveral muſcles ceaſes, the elaſtic cartilages extending themſelves to their natural ſituation, depreſs the upper ribs, and the *ſternum* ſubſides;—— the diaphragm is thruſt up by the *viſcera abdominalia*, and the oblique and tranſverſe muſcles of the belly ſerve to draw the inferior ribs inwards at the ſame time.———By theſe cauſes, the cavity of the breaſt is diminiſhed in all its dimenſions.

Though the motions above deſcribed of the ribs and *ſternum*, eſpecially of the latter bone, are ſo ſmall in the mild reſpiration of a healthy perſon, that we can ſcarce obſerve them; yet they are manifeſt whenever we deſignedly increaſe our reſpiration, or are obliged to do it after exerciſe, and in ſeveral diſeaſes.

OF

OF THE SUPERIOR EXTREMITIES.

AUthors are much divided in their opinions about the number of bones which each *ſuperior extremity* * ſhould be ſaid to conſiſt of, ſome deſcribing the *clavicle* and *ſcapula* as part of it, others claſſing theſe two bones with thoſe of the *thorax:* But ſince moſt quadrupeds have no *clavicles*, and the human *thorax* can perform its functions right when the *ſcapula* is taken away (*a*), whereas it is impoſſible for us to have the right uſe of our arms without theſe bones; I muſt think that they belong to the *ſuperior extremities*; and therefore ſhall divide each of them into the *ſhoulder*, *arm*, *fore-arm* and *hand*.

The *SHOULDER* conſiſts of the *clavicle* and *ſcapula*.

CLAVICULA, or *collar-bone* †, is the long crooked bone, in figure like an *Italic ſ*, placed almoſt horizontally between the upper lateral part of the *ſternum*, and what is commonly called the top of the ſhoulder, which as a *clavis* or beam, it bears off from the trunk of the body.

The *clavicle*, as well as other long round bones, is larger at its two ends, than in the middle. The end next to the *ſternum* ‡ is triangular:

* Κωλα, γῦα, ἐκφυαδες, Enata, adnata, explantata membra, artus.

(*a*) Philoſoph. tranſact. numb. 449. § 5.

† Os jugulare, jugulum, furcula, ligula, clavis, humerus quibuſdam.

‡ Παρασφαγις.

triangular: The angle behind is conſiderably produced, to form a ſharp ridge, to which the tranſverſe ligament extended from one clavicle to the other is fixed (*a*).—The ſide oppoſite to this is ſomewhat rounded.—The middle of this protuberant end is as irregularly hollowed, as the cavity in the *ſternum* for receiving it is raiſed; but in a recent ſubject, the irregular concavity of both are ſupplied by a moveable cartilage, which is not only much more cloſely connected every where by ligaments to the circumference of the articulation, than thoſe of the lower jaw are; but it grows to the two bones at both its internal and external end; its ſubſtance at the internal end being ſoft, but very ſtrong, and reſembling the intervertebral cartilages (*b*).

From this internal end, the *clavicle*, for about two fifths of its length, is bended obliquely forwards and downwards. On the upper and fore-part of this curvature a ſmall ridge is ſeen, with a plain rough ſurface before it; whence the *muſculus ſterno-hyoideus* and *ſterno-maſtoideus* have in part their origin.—Near the lower angle a ſmall plain ſurface is often to be remarked, where the firſt rib and this bone are contiguous (*c*), and are connected by a firm ligament (*d*).—From this a rough plain ſurface is extended outwards, where the pecto-

(*a*) Riolan. Encheirid. anat. lib. 6. cap. 13.——Winſlow, Expoſ. anat. des os frais, § 248.—Weitbrecht. Act. Petropolit. tom. 4. p. 255. et. Syndeſmolog ſect. 2. I. § 3.

(*b*) Weitbrecht, Syndeſmolog. ſect. 2. I. § 6.

(*c*) Dionis, Sixieme demonſt. des os.

(*d*) Weitbrecht, Syndeſmolog. ſect. 2. I. § 7.

ral muſcle has part of its origin.——Behind, the bone is made flat and rough by the inſertion of the larger ſhare of the ſubclavian muſcle.———After the clavicle begins to be bended backwards, it is round, but ſoon after becomes broad and thin; which ſhape it retains to its external end.———Along the external concavity, a rough ſinuoſity runs, from which ſome part of the deltoid muſcle takes its riſe: ——Oppoſite to this, on the convex edge, a ſcabrous ridge gives inſertion to a ſhare of the *cucullaris* muſcle. The upper ſurface of the clavicle here is flat; but the lower is hollow, for lodging the beginning of the *muſculus ſubclavius*; and towards its back-part a tubercle riſes, to which, and a roughneſs near it, the ſtrong ſhort thick ligament connecting this bone to the *coracoid* proceſs of the *ſcapula* is fixed.

The external end * of this bone is horizontally oblong, ſmooth, ſloping at the poſterior ſide, and tipped in a recent ſubject with a cartilage, for its articulation with the *acromion ſcapulæ*.———Round this the bone is ſpongy, for the firmer connection of the ligaments.

The medullary arteries, having their direction obliquely outwards, enter the clavicles by one or more ſmall paſſages in the middle of their back part.

The ſubſtance of this bone is the ſame as of the other round long bones.

The triangular unequal interior end of each *clavicle*, has the cartilage above deſcribed interpoſed betwixt it and the irregular cavity of the *ſternum*.——The ligaments, which

† Ἐπωμὶς.

which ſurround this articulation to ſecure it, are ſo ſhort and ſtrong, that little motion can be allowed any way; and the ſtrong ligament that is ſtretched acroſs the upper *furcula* of the *ſternum*, from the poſterior prominent angle of the one clavicle, to the ſame place of the other clavicle, ſerves to keep each of theſe bones more firmly in their place. ——By the aſſiſtance, however, of the moveable intervening cartilage, the clavicle can, at this joint, be raiſed or depreſſed, and moved backwards and forwards ſo much, as that the external end, which is at a great diſtance from that axis, enjoys very conſpicuous motions.—The articulation of the exterior end of the clavicle ſhall be conſidered after the deſcription of the *ſcapula*.

The clavicles of infants are not deficient in any of their parts; nor have they any epiphyſes at their extremities joined afterwards to their bodies, as moſt other ſuch long bones have, which preſerves them from being bended too much, and from the danger of any unoſſified parts being ſeparated by the force which pulls the arms forwards.

The uſes of the clavicles are, to keep the *ſcapulæ*, and conſequently all the *ſuperior extremities*, from falling in and foreward upon the *thorax*; by which, as in moſt quadrupeds, the motions of the arms would be much confined, and the breaſt made too narrow.——The clavicles likewiſe afford origin to ſeveral muſcles, and a defence to large veſſels.

From the ſituation, figure, and uſe of the clavicles, it is evident, that they are much ex-

poſed to fractures; that their broken parts muſt generally go by each other; and that they are difficultly kept in their place afterwards.

SCAPULA, or *ſhoulder-blade* *, is the triangular bone ſituated on the out-ſide of the ribs, with its longeſt ſide called its *baſe*, towards the ſpinal proceſſes of the *vertebræ*, and with the angle at the upper part of this ſide about three inches, and the lower angle at a greater diſtance from theſe proceſſes.—The back-part of the *ſcapula* has nothing but the thin ends of the *ſerratus anticus major* and *ſubſcapularis* muſcles between it and the ribs: But as this bone advances forwards, its diſtance from the ribs increaſes.——The upper or ſhorteſt ſide, called the *ſuperior coſta* of the *ſcapula* is nearly horizontal, and parallel with the ſecond rib.———The lower ſide, which is named the *inferior coſta*, is extended obliquely from the third to the eighth rib.—The ſituation of this bone, here deſcribed, is when people are ſitting or ſtanding in a ſtate of inactivity, and allow the members to remain in the moſt natural eaſy poſture.—The inferior angle of the *ſcapula* is very acute; the upper one is near to a right angle; and what is called the anterior, does not deſerve the name, for the two ſides do not meet to form an angle. ——The body of this bone is concave towards the ribs, and convex behind, where it has the name of *dorſum* †.——Three proceſſes are generally

* Ωμοπλατος, ετιγωτιον, latitudo humeri, ſcoptulum vel ſcutulum opertum, ſpatula, ala, humerus, clypeus, ſcutum thoracis.

† Χελ'ι'ον.

nerally reckoned to proceed from the *ſcapula*. ——The firſt is the large ſpine that riſes from its convex ſurface behind, and divides it unequally.——The ſecond proceſs ſtands out from the fore part of the upper ſide; and, from its imaginary reſemblance to a crow's beak, is named *coracoides* *.——The third proceſs is the whole thick bulbous fore-part of the bone.

After thus naming the ſeveral conſtituent parts of the *ſcapula*, the particular deſcription will be more eaſily underſtood.

The *baſe*, which is tipped with cartilage in a young ſubject, is not all ſtreight: For above the ſpine, it runs obliquely forwards to the ſuperior angle; that here it might not be too protuberant backwards, and ſo bruiſe the muſcles and teguments: Into the oblique ſpace the *muſculus patientiæ* is inſerted.——At the root of the ſpine, on the back-part of the baſe, a triangular plain ſurface is formed, by the preſſure of the lower fibres of the *trapezius*.—— Below this the edge of the *ſcapula* is ſcabrous and rough, for the inſertion of the *ſerratus major anticus* and *rhomboid* muſcles.

The back-part of the inferior angle is made ſmooth by the *latiſſimus dorſi* paſſing over it. This muſcle alſo alters the direction of the *inferior coſta* ſome way forwards from this angle: and ſo far it is flatted behind by the origin of the *teres major*.——As the *inferior coſta* advances forward, it is of conſiderable thickneſs, is ſlightly hollowed and made ſmooth behind by the *teres minor*, while it has a *foſſa* formed

* Anchoroides, ſigmoides, digitalis, anciſtroides.

into it below by part of the *ſubſcapularis*; and between the two a ridge with a ſmall depreſſion appears, where the *longus extenſor cubiti* has its origin.

The *ſuperior coſta* is very thin; and near its fore-part there is a ſemi lunar nitch, from one end of which to the other a ligament is ſtretched; and ſometimes the bone is continued, to form one, or ſometimes two holes for the paſſage of the ſcapular blood-veſſels and nerves.——Immediately behind this *ſemilunar* cavity the *coraco-hyoid* muſcle has its riſe.—— From the nitch to the termination of the *foſſa* for the *teres minor*, the *ſcapula* is narrower than any where elſe, and ſupports the third proceſs. This part has the name of *cervix*.

The whole *dorſum* of the *ſcapula* is always ſaid to be convex; but, by reaſon of the raiſed edges that ſurround it, it is divided into two cavities by the ſpine, which is ſtretched from behind forwards, much nearer to the ſuperior than to the inferior *coſta*.—The cavity above the ſpine is really concave where the *ſupra-ſpinatus* muſcle is lodged; while the ſurface of this bone below the ſpine, on which the *infra-ſpinatus* muſcle is placed, is convex, except a *foſſa* that runs at the ſide of the *inferior coſta*.

The internal or anterior ſurface of this bone is hollow, except in the part above the ſpine, which is convex.——The *ſubſcapularis* muſcle is extended over this ſurface, where it forms ſeveral ridges and intermediate depreſſions, commonly miſtaken for prints of the ribs; they point out the interſtices of the bundles of

fibres

fibres of which the *ſubſcapularis* muſcle is compoſed (*a*).

The ſpine * riſes ſmall at the baſe of the *ſcapula*, and becomes higher and broader as it advances forward.——On the ſides it is unequally hollowed and crooked, by the actions of the adjacent muſcles.——Its ridge † is divided into two rough flat ſurfaces: Into the upper one, the *trapezius* muſcle is inſerted; and the lower one has part of the *deltoid* fixed to it.——The end of the ſpine, called *acromion* ‡, or top of the ſhoulder, is broad and flat, and is ſometimes only joined to the ſpine by a cartilage (*b*).——The anterior edge of the *acromion* is flat, ſmooth, and covered with a cartilage, for its articulation with the external end of the clavicle; and it is hollowed below, to allow a paſſage to the *infra* and *ſupra ſpinati* muſcles, and free motion to the *os humeri*.

The *coracoid* § proceſs is crooked, with its point inclining forwards; ſo that a hollow is left at the lower-ſide of its root, for the paſſage of the *infra-ſcapularis* muſcle.——The end of this proceſs is marked with three plain ſurfaces. Into the internal, the *ſerratus minor anticus* is inſerted: From the external, one head of the *biceps flexor cubiti* riſes: and from the lower one, the *coracobrachialis*

(*a*) Winſlow, in Memoires de l' acad. des ſciences, 1722.

* Ραχις, ὑπερόχη ὠμοπλατῶν, eminentia ſcapularm.

† Pterigium, criſta.

‡ Ἐπωμις ἀγκυροειδὴς, κορακοειδὴς, κατακλεὶς, acromii os, ſummus armus, roſtrum porcinum, proceſſus digitalis.

(*b*) Sue Trad. d' oſteol. p. 160,

§ Ἀγκυροειδὴς, σίγμοειδὴς, roſtriformis.

has its origin.——At the upper part of the root of this proceſs, immediately before the *ſemilunar* cavity, a ſmooth tubercle appears, where a ligament from the *clavicle* is fixed. From all the external ſide of this coracoid *apophyſe*, a broad ligament goes out, which becomes narrower where it is fixed to the *acromion*.——The ſharp pain, violent inflammation, and tedious courſe of contuſions in this part, are probably owing to theſe tendons and ligaments being hurt.

From the *cervix ſcapulæ* the third proceſs is produced. The fore-part of this is formed into a *glenoid* cavity *, which is of the ſhape of the longitudinal ſection of an egg, being broad below, and narrow above.—— Between the brims of this hollow and the fore-part of the root of the ſpine, a large ſinuoſity is left for the tranſmiſſion of the *ſupra* and *infra ſpinati* muſcles; and on the upper-part of theſe brims we may remark a ſmooth ſurface, where the ſecond head of the *biceps flexor cubiti* has its origin.——The root of the *ſupercilia* is rough all round, for the firmer adheſion of the capſular ligament of the articulation, and of the cartilage which is placed ou theſe brims, where it is thick, but becomes very thin as it is continued towards the middle of the cavity, which it lines all over.

The medullary veſſels enter the *ſcapula* near the baſe of the ſpine.

The

* Ωμοκότυλος.

The ſubſtance of the *ſcapula*, as in all other broad flat bones, is cellular, but of an unequal thickneſs; for the neck and third proceſs are thick and ſtrong. The inferior *coſta*, ſpine, and coracoid proceſs, are of a middle thickneſs; and the body is ſo preſſed by the muſcles, as to become thin and diaphanous.

The *ſcapula* and clavicle are joined by plain ſurfaces, tipped with cartilage*; by which neither bone is allowed any conſiderable motion, being tightly tied down by the common capſular ligament, and by a very ſtrong one which proceeds from the coracoid proceſs; but divides into two before it is fixed into the *clavicle*, with ſuch a direction, as either can allow this bone to have a ſmall rotation, in which its poſterior edge turns more backwards, while the anterior one riſes farther forewards; or it can yield to the forepart of the *ſcapula* moving downwards, while the back-part of it is drawn upwards; in both which caſes, the oblong ſmooth articulated ſurfaces of the *clavicle* and *ſcapula* are not in the ſame plane, but ſtand a little tranſverſely, or acroſs each other, and thereby preſerve this joint from luxations, to which it would be ſubject, if either of the bones was to move on the other perpendicularly up and down, without any rotation.——Sometimes a moveable ligamentous cartilage is found in this joint; otherwhiles ſuch a cartilage is only interpoſed at the anterior half of it; and in ſome old ſubjects I have found a ſeſamoid

* Acromion. κατακλεις, clauſuræ.

bone here (*a*).——The *ſcapula* is connected to the head, *os hyoides*, *vertebræ*, ribs, and arm-bone, by muſcles, that have one end faſtened to theſe bones, and the other to the *ſcapula*, which can move it upwards, downwards, backwards, or forwards; by the quick ſucceſſion of theſe motions, its whole body is carried in a circle. But being alſo often moved as upon an axis perpendicular to its plane, its circumference turns in a circle whoſe center this axis is (*b*). Whichever of theſe motions it performs, it always carries the outer end of the clavicle and the arm along with it.——The *glenoid* cavity of this bone receives the *os humeri*, which plays in it as a ball in a ſocket, as will be explained more hereafter.

The uſe of the *ſcapula* is, to ſerve as a *fulcrum* to the arm; and, by altering its poſition on different occaſions, to allow always the head of the *os humeri* a right ſituated ſocket to move in; and thereby to aſſiſt and to enlarge greatly the motions of the *ſuperior extremity*, and to afford the muſcles which riſe from it more advantageous actions, by altering their directions to the bone which they are to move.——This bone alſo ſerves to defend the back-part of the *thorax*, and is often employed to ſuſtain weights, or to reſiſt forces, too great for the arm to bear.

The baſe, *acromion*, coracoid proceſs, and head of the *ſcapula*, are all in a cartilaginous ſtate at birth; and the three firſt are joined as *epiphyſes*; while the head, with the *glenoid* cavity,

(*a*) Jac. Sylv. Iſagog. anat. lib. 1. cap. 2.
(*b*) See Winſlow, Memoires de l'acad. des ſciences, 1726.

cavity, is not formed into a distinct separate bone, but is gradually produced by the ossification of the body of this bone being continued forwards.

The *ARM* has only one bone, best known by the *Latin* name of *os humeri* *; which is long, round and nearly streight.

The upper end of this bone † is formed into a large round smooth head, whose middle point is not in a streight line with the axis of the bone, but stands obliquely backwards from it.——The extent of the head is distinguished by a circular *fossa* surrounding its base, where the head is united to the bone, and the capsular ligament of the joint is fixed.——Below the fore-part of its base two tubercles stand out: The smallest one, which is situated most to the inside, has the tendon of the *subscapularis* muscle inserted into it.——The larger more external protuberance is divided, at its upper part, into three smooth plain surfaces; into the anterior of which, the *musculus supra-spinatus*; into the middle or largest, the *infra-spinatus*; into the one behind, the *teres minor*, is inserted.——Between these two tubercles, exactly in the fore-part of the bone, a deep long *fossa* is formed, for lodging the tendinous head of the *biceps flexor cubiti*; which, after passing, in a manner peculiar to itself, through the cavity of the articulation, is tied down by a tendinous sheath extended across the *fossa*; in which, and in the neighbouring tubercles, are several

† Ἀκρολία, ωλένη, os brachii, armi, adjutorium, parvum brachium, canna brachii.

* Acrocolium.

ſeveral remarkable holes, which are penetrated by the tendinous and ligamentous fibres, and by veſſels.——On each ſide of this *foſſa*, as it deſcends in the *os humeri*, a rough ridge, gently flatted in the middle, runs from the roots of the tubercles.——The tendon of the *pectoral* muſcle is fixed into the anterior of theſe ridges, and the *latiſſimus dorſi*, and *teres major*, are inſerted into the internal one. ——A little behind the lower end of this laſt, another rough ridge may be obſerved, where the *coraco-brachialis* is inſerted.——From the back part of the root of the largeſt tubercle a ridge alſo is continued, from which the *brevis extenſor cubiti* riſes.——This bone is flatted on the inſides, about its middle, by the belly of the *biceps flexor cubiti*.——In the middle of this plain ſurface, the entry of the medullary artery is ſeen ſlanting obliquely downwards. ——At the fore ſide of this plane the bone riſes in a ſort of ridge, which is rough, and often has a great many ſmall holes in it, where the tendon of the ſtrong *deltoid* muſcles is inſerted; on each ſide of which the bone is ſmooth and flat, where the *brachiæus internus* riſes. The exterior of theſe two flat ſurfaces is the largeſt; behind it a ſuperficial ſpiral channel, formed by the *muſcular* nerve and the veſſels that accompany it, runs from behind forwards and downwards.—The body of the *os humeri* is flatted behind by the extenſors of the fore-arm.——Near the lower end of this bone, a large ſharp ridge is extended on its outſide, from which the *muſculus ſpinator radii longus*, and the longeſt head

head of the *extenſor carpi radialis* riſe.——Oppoſite to this, there is another ſmall ridge to which the *aponeurotic* tendon, that gives origin to the fibres of the internal and external *brachiæi* muſcle is fixed; and from a little depreſſion on the fore-ſide of it, the *pronator radii teres* riſes.

The body of the *os humeri* becomes gradually broader towards the lower end, where it has ſeveral proceſſes: at the roots of which, there is a cavity before, and another behind*. The anterior is divided by a ridge into two; the external, which is the leaſt, receives the end of the *radius*; and the internal receives the *coronoid* proceſs of the *ulna* in the flections of the fore-arm, while the poſterior deep triangular cavity lodges the *olecranon* in the extenſions of that member.——The bone betwixt theſe two cavities is preſſed ſo thin by the proceſſes of the *ulna*, as to appear diaphanous in ſeveral ſubjects.——The ſides of the poſterior cavity are ſtretched out into two proceſſes, one in each ſide: Theſe are called *condyles*; from each of which a ſtrong ligament goes out to the bones of the *fore arm*.——The external *condyle*, which has an oblique direction alſo forwards in reſpect of the internal, when the arm is in the moſt natural poſture (*a*), is equally broad, and has an obtuſe ſmooth head riſing from it forwards.——From the rough part of the *condyle*, the inferior head of the *bicornis*, the *extenſor digitorum communis*, *extenſor carpi ulnaris*, *anconæus*,

* βαθμίδες.

(*a*) Winſlow, Memoires de l'acad. des ſciences, 1722.

conœus, and ſome part of the *ſupinator radii brevis*, take their riſe; and on the ſmooth head the upper end of the *radius* plays.——Immediately on the outſide of this, there is a ſinuoſity made by the ſhorter head of the *bicornis* muſcle, upon which the *muſcular* nerve is placed.——The internal *condyle* is more pointed and protuberant than the external, to give origin to ſome part of the *flexor carpi radialis*, *pronator radii teres*, *palmaris longus*, *flexor digitorum ſublimis*, and *flexor carpi ulnaris*.--Between the two *condyles*, is the *trochlea* or pully, which conſiſts of two lateral protuberances, and a middle cavity, that are ſmooth and covered with cartilarge.—When the forearm is extended, the tendon of the internal *brachiœus* muſcle is lodged in the fore part of the cavity of this pully.—The external protuberance, which is leſs than the other, has a ſharp edge behind; but forwards, this ridge is obtuſe, and only ſeparated from the little head, already deſcribed, by a ſmall *foſſa*, in which the joined edges of the *ulna* and *radius* move.—The internal protuberance of the pully is largeſt and higheſt; and therefore in the motions of the *ulna* upon it, that bone would be inclined outwards, was it not ſupported by the *radius* on that ſide.—Between this internal protuberance and *condyle*, a ſinuoſity may be remarked, where the *ulnar* nerve paſſes.

The ſubſtance and the internal ſtructure of the *os humeri* is the ſame, and diſpoſed in the ſame way, as in other long bones.

The round head at the upper end of this bone is articulated with the *glenoid* cavity of the

the *ſcapula*; which being ſuperficial, and having long ligaments, allows the arm a free and extenſive motion.——Theſe ligaments are however conſiderably ſtrong. For, beſides the common capſular one, the tendons of the muſcles perform the office, and have been deſcribed under the name of *ligaments*.——Then the *acromion* and *coracoid* proceſs, with the ſtrong broad ligaments ſtretched betwixt them, ſecure the articulation above, where the greateſt and moſt frequent force is applied to thruſt the head of the bone out of its place. It is true that there is not near ſo ſtrong a defence at the lower part of the articulation; but in the ordinary poſtures of the arm, that is, ſo long as it is at an acute angle with the trunk of the body, there cannot be any force applied at this place to occaſion a luxation, ſince the joint is protected ſo well above.

The motions which the arm enjoys by this articulation, are to every ſide; and by the ſucceſſion of theſe different motions, a circle may be deſcribed. Beſides which, the bone performs a ſmall rotation round its own *axis*. But though this can be performed with the round head in all poſitions; yet as theſe vary, the effects upon the body of the bone are very different: For, if the middle of the head is the center of rotation, as it is when the arm hangs down by the ſide, the body of the bone is only moved forwards and backwards; becauſe the *axis* of motion of the head is nearly at right angles with the length of the bone whereas,

(*a*); whereas, when the arm is raiſed to right angles with the trunk of the body, the center of motion, and the axis of the bone, come to be in the ſame ſtreight line; and therefore the body of the *os humeri* performs the ſame motion with its head.——————Though the motions of the arm ſeem to be very extenſive, yet the larger ſhare of them depends on the motion of the *ſcapula*.—The lower end of the *os humeri* is articulated with the bones of the fore-arm, and carries them with it in all its motions, but ſerves as a baſe on which they perform the motions peculiar to themſelves; as ſhall be deſcribed afterwards.

Both the ends of this bone are cartilaginous in a new-born infant, and the large head with the two tubercles, and the *trochlea* with the two *condyles*, become *epiphyſes* before they are united to the body of the bone.

The *FORE-ARM*† conſiſts of two long bones, the *ulna* and *radius*; whoſe ſituation, in reſpect of each other, is oblique in the leaſt ſtraining or moſt natural poſture; that is, the *ulna* is not directly behind, nor on the outſide of the *radius*, but in a middle ſituation between theſe two, and the *radius* croſſes it.—The ſituation however of theſe two bones, and of all the other bones of the *ſuperior extremity* that are not yet deſcribed, is frequently altered; and therefore, to ſhun repetitions, I deſire it may be now remarked, that, in the remaining account of the *ſuperior extremity*, I underſtand by the term

(*a*) Hippocra. de articul. § 1.

† Cubitus, πῆχυς, ωλένη, πυγών, ulna, lacertus.

term of *poſterior*, that part which is in the ſame direction with the back of the hand; by *anterior*, that anſwering to the palm; by *internal*, that on the ſame ſide with the thumb; by *external*, the ſide neareſt to the little finger; ſuppoſing the hand always to be in a middle poſition between *pronation* and *ſupination*.

ULNA †, ſo named from its being uſed as a meaſure, is the longeſt of the two bones of the fore-arm, and ſituated on the outſide of the *radius*.

At the upper end of the *ulna* are two proceſſes.—The poſterior is the largeſt, and formed like a hook, whoſe concave ſurface moves upon the pully of the *os humeri*, and is called *olecranon* ‡, or top of the cubit.—The convex back part of it is rough and ſcabrous, where the *longus*, *brevis*, and *brachiæus externus*, are inſerted. The *olecranon* makes it unneceſſary that the tendons of the extenſor muſcles ſhould paſs over the end of the *os humeri*; which would have been of ill conſequence in the great flections of this joint, or when any conſiderable external force is applied to this part (*a*).—The anterior proceſs is not ſo large, nor does it reach ſo high as the one behind; but is ſharper at its end, and therefore is named *coronoid*.—Between theſe two proceſſes, a large ſemicircular or *ſigmoid* concavity is left; the ſurface of which, on

† Cubitus, πῆχυς, προτηχυον, focile majus, canna vel arundo major, et inferior brachii.

‡ Αγκῶν, gibber cubitis, additamentum necatum.

(*a*) Winſlow, Expoſition anatomique du corps humain, traite des os ſecs, § 979.

on each ſide of a middle riſing, is ſlanting, and exactly adapted to the pully of the bone of the arm.——Acroſs the middle of it, there is a ſmall ſinuoſity for lodging mucilaginous glands; where, as well as in a ſmall hollow on the internal ſide of it, the cartilage that lines the reſt of its ſurface is wanting.——Round the brims of this concavity the bone is rough, where the capſular ligament of the joint is implanted.——Immediately below the *olecranon*, on the back-part of the *ulna*, a flat triangular ſpongy ſurface appears, on which we commonly lean.—At the internal ſide of this, there is a larger hollow ſurface, where the *muſculus anconæus* is lodged; and the ridge at the inſide of this gives riſe to the *muſculus ſupinator radii brevis*.——Between the top of the ridge and the *coronoid* proceſs is the ſemilunated ſmooth cavity, lined with cartilage, in which, and a ligament extended from the one to the other end of this cavity, the round head of the *radius* plays.—Immediately below it a rough hollow gives lodging to mucilaginous glands.—Below the root of the *coronoid* proceſs, this bone is ſcabrous and unequal, where the *brachiæus internus* is inſerted.—On the outſide of that we obſerve a ſmooth concavity, where the beginning of the *flexor digitorum profundus* ſprouts out.

The body of the *ulna* is triangular.—The internal angle is very ſharp where the ligament that connects the two bones is fixed:—The ſides, which make this angle, are flat and rough, by the action and adheſion of the many muſcles which are ſituated here.——At the diſtance

distance of one third of the length of the *ulna* from the top, in its fore-part, the passage of the medullary vessels is to be remarked slanting upwards.—The external side of this bone is smooth, somewhat convex, and the angles at each edge of it are blunted by the pressure of the muscles equally disposed about them.

As this bone descends, it becomes gradually smaller; so that its lower end terminates in a little head, standing on a small neck.—Towards the fore but outer part of which last, an oblique ridge runs, that gives rise to the *pronator radii quadratus*.——The head is round, smooth, and covered with a cartilage on its internal side, to be received into the semilunar cavity of the *radius*; while a *styloid* process † rises from its outside, to which is fixed a strong ligament that is extended to the *os cuneiforme* and *pisiforme* of the wrist.—Between the back-part of that internal smooth side and this process, a sinuosity is left for the tendon of the *extensor carpi ulnaris*.——On the fore-part of the root of the process, such another depression may be remarked for the passage of the *ulnar* artery and nerve.—The end of the bone is smooth, and covered with a cartilage.—Between it and the bones of the wrist, a doubly-concave moveable cartilage is interposed, which is a continuation of the cartilage that covers the lower ends of the *radius*, and is connected loosely to the root of the *styloid* process, and to the rough cavity there; in which mucilaginous glands are lodged.

The

† Γραφοειδῆ, maleolus externus.

The *ulna* is articulated above with the lower end of the *os humeri*, where theſe bones have depreſſions and protuberances correſponding to each other, ſo as to allow an eaſy and ſecure extenſions of the fore-arm to almoſt a ſtreight line with the arm, and flection to a very acute angle; but, by the ſlanting poſition of the pully, the lower part of the fore-arm is turned outwards in the extenſion, and inwards in the flection (*a*); and a very ſmall kind of rotation is likewiſe allowed in all poſitions, eſpecially when the ligaments are moſt relaxed by the fore-arm being in a middle degree of flection. ——The *ulna* is alſo articulated with the *radius* and *corpus*, in a manner to be related afterwards.

RADIUS *, ſo called from its imagined reſemblance to a ſpoke of a wheel, or to a weaver's beam, is the bone placed at the inſide of the fore-arm. Its upper end is formed into a circular little head, which is hollowed for an articulation with the tubercle at the ſide of the pully of the *os humeri*; and the half of the round circumference of the head next to the *ulna* is ſmooth, and covered with a cartilage, in order to be received into the ſemilunated cavity of that bone.—Below the head, the *radius* is much ſmaller; therefore this part is named its *cervix*, which is made round by the action of the *ſupinator radii brevis*.—At the external root of this neck, a tuberous proceſs riſes; into the outer part of which the *biceps flexor cubiti* is inſerted.——From this a ridge runs downwards and inwards, where the *ſupinator*

(*a*) Winſlow, Memoires de l'acad des ſciences, 1722.

* Κερχις, παραπήχιον, focile minus, canna, minor, arundo minor.

ſupinator radii brevis is inſerted; and a little below, and behind this ridge, there is a rough ſcabrous ſurface, where the *pronator radii teres* is fixed.

The body of the *radius* is not ſtreight, but convex on its internal and poſterior ſurfaces; where it is alſo made round by the equal preſſure of the circumjacent muſcles, particularly of the *extenſors* of the thumb; but the ſurfaces next to the *ulna* are flatted and rough, for the origin of the muſcles of the hand; and both terminate in a common ſharp ſpine, to which the ſtrong ligament extended betwixt the two bones of the fore-arm is fixed.—A little below the beginning of the plain ſurface, on its fore-part, where the *flexor* muſcle of the laſt joint of the thumb takes its origin, the paſſage of the medullary veſſels is ſeen ſlanting upwards. —The *radius* becomes broader and flatter towards the lower end, eſpecially on its fore-part, where its *pronator quadratus* muſcle is ſituated.

The lower end of the *radius* is larger than the ſuperior; though not in ſuch a diſproportion as the upper end of the *ulna* is larger than its lower end.—Its back-part has a flat ſtrong ridge in the middle, and *foſſæ* on each ſide.— In a ſmall groove, immediately on the outſide of the ridge, the tendon of the *extenſor tertii internodii policis* plays.—In a large one beyond this, the tendons of the *indicator* and of the common *extenſor* muſcles of the fingers paſs.—Contiguous to the *ulna*, there is a ſmall depreſſion made by the *extenſor minimi digiti*. —On the inſide of the ridge there is a broad depreſſion,

depreſſion, which ſeems again ſubdivided, where the two tendons of the *bicornis*, or *extenſor carpi radialis*, are lodged.—The internal ſide of this end of the *radius* is alſo hollowed by the extenſors of the firſt and ſecond joint of the thumb; immediately above which, a little rough ſurface ſhews where the *ſupinator radii longus* is inſerted.——The ridges at the ſides of the grooves, in which the tendons play, have an annular ligament fixed to them, by which the ſeveral ſheaths for the tendons are formed.——The fore-part of this end of the *radius* is alſo depreſſed, where the flexors of the fingers and *flexor carpi radialis* paſs.——The external ſide is formed into a ſemilunated ſmooth cavity, lined with a cartilage, for receiving the lower end of the *ulna*.———The loweſt part of the *radius* is formed into an oblong cavity; in the middle of which is a ſmall tranſverſe riſing, gently hollowed, for lodging mucilaginous glands; while the riſing itſelf is inſinuated into the conjunctions of the two bones of the wriſt that are received into the cavity.——The internal ſide of this articulation is fenced by a remarkable proceſs * of the *radius*, from which a ligament goes out to the wriſt, as the *ſtyloid* proceſs of the *ulna* with its ligament guards it on the outſide.

The ends of both the bones of the fore arm being thicker than the middle, there is a conſiderable diſtance between the bodies of theſe bones; in the larger part of which a ſtrong tendinous, but thin ligament is extended, to give a large enough ſurface for the origin of

* Malleolus internus, proceſſus ſtyloides.

of the numerous fibres of the muſcles ſituated here, that are ſo much ſunk between the bones, as to be protected from injuries, which they would otherwiſe be expoſed to. But this ligament is wanting near the upper end of the fore-arm, where the *ſupinator radii brevis*, and *flexor digitorum profundus*, are immediately connected (*a*).

Both ends of the bones of the fore-arm are firſt cartilages, and then *epiphyſes* in children.

As the head of the *radius* receives the tubercle of the *os humeri*, it is not only bended and extended along with the *ulna*, but may be moved round its *axis* in any poſition; and that this motion round its *axis* may be ſufficiently large, the ligament of the articulation is extended farther down than ordinary on the neck of this bone, before it is connected to it; and it is very thin at its upper and lower part, but makes a firm riſing in the middle.——This bone is alſo joined to the *ulna* by a double articulation; for above, a tubercle of the *radius* plays in a ſocket of the *ulna*; whilſt below, the *radius* gives the ſocket, and the *ulna* the tubercle: But then the motion performed in theſe two is very different; for at the upper end, the *radius* does no more than turn round its axis; while at the lower end, it moves in a ſort of *cycloid* upon the round part of the *ulna*; and as the hand is articulated and firmly connected here with the *radius*, they muſt move together.—

When

(*a*) Weitbrecht. Syndeſmolog. fig. 10, 11.

When the palm is turned uppermoſt, the *radius* is ſaid to perform the *ſupination*; when the back of the hand is above, it is ſaid to be *prone*. But then the quickneſs and large extent of theſe two motions are aſſiſted by the *ulna*, which, as was before obſerved, can move with a kind of ſmall rotation on the ſloping ſides of the pulley. This lateral motion, tho' very inconſiderable in the joint itſelf, is conſpicuous at the lower end of ſuch a long bone: and the ſtrong ligament connecting this lower end to the *carpus*, make the hand more readily to obey theſe motions.—When we deſign a large circular turn of our hand, we increaſe it by the rotation of the *os humeri*, and ſometimes employ the ſpine and *inferior extremities* to make theſe motions of pronation or ſupination of the hand large enough.

The *HAND** comprehends all from the joint of the wriſt to the points of the fingers. Its back-part is convex, for greater firmneſs and ſtrength; and it is concave before, for containing more ſurely and conveniently ſuch bodies as we take hold of.——One half of the hand has an obſcure motion in compariſon of what the other has, and ſerves as a baſe to the moveable half; which can be extended back very little farther than to a ſtreight line with the fore-arm, but can be conſiderably bended forwards.

As the bones that compoſe the hand are of different ſhapes and uſes, while ſeveral of them that are contiguous agree in ſome general characters; the hand is, on this account, commonly

* Ακρόχειρ, ſumma manus.

ly divided into the *carpus*, *metacarpus*, and *fingers*; among which laſt the thumb is reckoned.

The *CARPUS* * is compoſed of eight ſmall ſpongy bones, ſituated at the upper part of the hand. I ſhall deſcribe each of theſe bones, under a proper name taken from their figure (*a*); becauſe the method of ranging them by numbers leaves anatomiſts too much at liberty to debate very idly, which ought to be preferred to the firſt number: or, which is worſe, ſeveral, without explaining the order they obſerve, differently apply the ſame numbers, and ſo confound their readers.—But that the deſcription of theſe bones may be in the ſame order as they are found in the generality of anatomical books, I ſhall begin with the range of bones that are concerned in the moveable joint in the wriſt, or are connected to the fore-arm, and ſhall afterwards conſider the four that ſupport the thumb and *oſſa metacarpi* of the fingers.

The eight bones of the *carpus* are, *os ſcaphoides*, *lunare*, *cuneiforme*, *piſiforme*, *trapezium*, *trapezoides*, *magnum*, *unciforme*.

The *ſcaphoides* is ſituated moſt internally of thoſe that are articulated with the fore-arm.—The *lunare* is immediately on the outſide of the former.—The *cuneiforme* is placed ſtill more externally, but does not reach ſo high up as the other two.—The *piſiforme* ſtands forwards into the palm from the *cuneiforme*.—The *trapezium* is the firſt of the ſecond row, and is ſituated betwixt the *ſcaphoides* and firſt

* Κτεις, brachiale, prima palmæ pars, raſetta.

(*a*) Lyſer. Cult. anat. lib. 5. cap. 2.

joint of the thumb.—The *trapezoides* is immediately on the outside of the *trapezium*.—The *os magnum* is still more external.—The *unciforme* is farther to the side of the little finger.

*Os scaphoides** is the largest of the eight except one. It is convex above, concave and oblong below; from which small resemblance of a boat it has got its name.—Its smooth convex surface is divided by a rough middle *fossa*, which runs obliquely cross it.——The upper largest division is articulated with the *radius*.—Into the *fossa* the common ligament of the joint of the wrist is fixed; and the lower division is joined to the *trapezium* and *trapezoides*.—The concavity receives more than an half of the round head of the *os magnum*.—The external side of this hollow is formed into a semilunar plane, to be articulated with the following bone.—The internal, posterior, and anterior edges are rough, for fixing the ligaments that connect it to the surrounding bones.

Os lunare † has a smooth convex upper surface, by which it is articulated with the *radius*.——The internal side, which gives the name to the bone, is in the form of a crescent, and is joined with the *scaphoid*;—the lower surface is hollow, for receiving part of the head of the *os magnum*.—On the outside of this cavity is another smooth, but narrow oblong sinuosity, for receiving the upper end of the *os unciforme*:——On the outside of which

* Κοτυλοειδὲς, naviculare.

† Lunatum.

which a small round convexity is found, for its connection with the *os cuneiforme*.——Between the great convexity above, and the first deep inferior cavity, there is a rough *fossa*, in which the circular ligament of the joint of the wrist is fixed.

Os cuneiforme * is broader above, and towards the back of the hand, than it is below and forwards: which gives it the resemblance of a wedge.—The superior slightly convex surface is included in the joint of the wrist, being opposed to the lower end of the *ulna*.—Below this the cuneiform bone has a rough *fossa*, wherein the ligament of the articulation of the wrist is fixed.—On the internal side of this bone, where it is contiguous to the *os lunare*, it is smooth and slightly concave.—Its lower surface, where it is contiguous to the *os unciforme* is oblong, somewhat spiral, and concave.—Near the middle of its anterior surface a circular plane appears, where the *os pisiforme* is sustained.

Os pisiforme † is almost spherical, except one circular plane, or slightly hollow surface, which is covered with cartilage for its motion on the *cuneiforme* bone, from which its whole rough body is prominent forwards into the palm; having the tendon of the *flexor carpi ulnaris*, and a ligament from the *styloid* process of the *ulna*, fixed to its upper part; the *transverse* ligament of the wrist is connected to its internal side; ligaments extended to the *unciform* bone, and to the *os metacarpi* of the

* Triquetrum.
† Cartilaginosum, subrotundum, rectum.

little finger, are attached to its lower part; the *abductor minimi digiti* has its origin from its fore-part; and, at the internal ſide of it, a ſmall depreſſion is formed, for the paſſage of the ulnar nerve.

Trapezium * has four unequal ſides and angles in its back part, from which it has got its name.—Above, its ſurface is ſmooth, ſlightly hollowed, and ſemicircular, for its conjunction with the *os ſcaphoides*.—Its external ſide is an oblong concave ſquare, for receiving the following bone.—The inferior ſurface is formed into a pulley; the two protuberant ſides of which are external and internal. On this pulley the firſt bone of the thumb is moved.———At the external ſide of the external protuberance, a ſmall oblong ſmooth ſurface is formed by the *os metacarpi indicis*.—The fore-part of the *trapezium* is prominent in the palm, and, near to the external ſide, has a ſinuoſity in it, where the tendon of the *flexor carpi radialis* is lodged; on the ligamentous ſheath of which the tendon of the *flexor tertii internodii pollicis* plays: And ſtill more externally the bone is ſcabrous, where the *tranſverſe* ligament of the wriſt is connected, the *abductor* and *flexor primi internodii pollicis* have their origin, and ligaments go out to the firſt bone of the thumb.

Os trapezoides †, ſo called from the irregular quadrangular figure of its back part, is the ſmalleſt bone of the wriſt, except the *piſiforme*.——The figure of it is an irregular cube.

* Os cubiforme, trapezoides, multangulum majus.
† Trapezium, multangulum minus.

cube.——It has a ſmall hollow ſurface above, by which it joins the *ſcapboides*; a long convex one internally, where it is contiguous to the *trapezium*; a ſmall external one, for its conjunction with the *os magnum*; and an inferior convex ſurface, the edges of which are however ſo raiſed before and behind, that a ſort of pulley is formed, where it ſuſtains the *os metacarpi indicis*.

Os magnum *, ſo called becauſe it is the largeſt bone of the *carpus*, is oblong, having four quadrangular ſides, with a round upper end, and a triangular plain one below.—— The round head is divided by a ſmall riſing, oppoſite to the connection of the *os ſcapboides* and *lunare*, which together form the cavity for receiving it.—On the inſide a ſhort plain ſurface joins the *os magnum* to the *trapezoides*. ——On the outſide is a long narrow concave ſurface, where it is contiguous to the *os unciforme*.——The lower end, which ſuſtains the metacarpal bone of the middle finger, is triangular, ſlightly hollowed, and farther advanced on the internal ſide than on the external, having a conſiderable oblong depreſſion made on the advanced inſide by the metacarpal bone of the fore-finger; and generally there is a ſmall mark of the *os metacarpi digiti annularis* on its external ſide.

Os unciforme † has got its name from a thin broad proceſs that ſtands out from it forwards into the palm, and is hollow on its inſide, for affording paſſage to the tendons of

* Maximum, capitatum.
† Cuneiforme.

the flexors of the fingers.—To this process also the transverse ligament is fixed, that binds down and defends these tendons; and the *flexor* and *abductor* muscles of the little finger have part of their origin from it.—— The upper plain surface is small, convex, and joined with the *os lunare*:—The internal side is long, and slightly convex, adapted to the contiguous *os magnum*:—The external surface is oblique, and irregularly convex, to be articulated with the cuneiform bone:—— the lower end is divided into two concave surfaces; the external is joined with the metacarpal bone of the little finger, and the internal one is fitted to the metacarpal bone of the ring finger.

In the description of the preceding eight bones, I have only mentioned those plain surfaces covered with cartilage, by which they are articulated to each other, or to some other bones, except in some few cases, where something extraordinary was to be observed; and I have designedly omitted the other rough surfaces, lest, by crowding too many words in the description of such small bones, the whole should be unintelligible: But these scabrous parts of the bones may easily be understood, after mentioning their figure, if it is observed, that they are generally found only towards the back or palm of the hand; that they are all plain, larger behind than before; and that they receive the different ligaments, by which they are either connected to neighbouring bones, or to one another; for these ligaments cover all the bones, and are so accurately

curately applied to them, that, at firſt view, the whole *carpus* of a recent ſubject appears one ſmooth bone *(a)*.

As the ſurfaces of theſe bones are largeſt behind, the figure of the whole conjoined muſt be convex there, and concave before; which concavity is ſtill more increaſed by the *os piſiforme*, and proceſs of the *os unciforme*, ſtanding forwards on one ſide, as the *trapezium* does on the other: And the bones are ſecurely kept in this form, by the broad ſtrong tranſverſe ligament connected to theſe parts of them that ſtand prominent into the palm of the hand.—The convexity behind renders the whole fabric ſtronger, where it is moſt expoſed to injuries; and the large anterior hollow is neceſſary for a ſafe paſſage to the numerous veſſels, nerves, and tendons of the fingers.

The ſubſtance of theſe bones is ſpongy and cellular, but ſtrong in reſpect of their bulk.

The three firſt bones of the *carpus* make an oblong head, by which they are articulated with the cavity at the lower ends of the bones of the fore-arm; ſo as to allow motion to all ſides, and, by a quick ſucceſſion of theſe motions, they may be moved in a circle. But as the joint is oblong, and therefore the two dimenſions are unequal, no motion is allowed to the *carpus* round its axis, except what it

(a) Galen, de uſu part. lib 2. cap. 8. For a particular deſcription of theſe ligaments, ſee Weitbrecht. Syndeſmolog. p. 5—68.

has in the pronation and ſupination along with the *radius*.—The articulation of the firſt three bones of the ſuperior row, with the bones of the inferior, is ſuch as allows of motion, eſpecially backwards and forwards; to the ſecurity and eaſineſs of which the reception of the *os magnum* into the cavity formed by the *ſcaphoides* and *lunare* contributes conſiderably: And the greateſt number of the muſcles that ſerve for the motion of the wriſt on the *radius*, being inſerted beyond the conjunction of the firſt row of bones with the ſecond, act equally on this articulation as they do on the former; but the joint formed with the *radius* being the moſt eaſily moved, the firſt effect of theſe muſcles is on it; and the ſecond row of the *carpus* is only moved afterwards. By this means a larger motion of the wriſt is allowed, than otherwiſe it could have had ſafely: For, if as large motion had been given to one joint, the angle of flection would have been very acute, and the ligaments muſt have been longer than was conſiſtent with the firmneſs and ſecurity of the joint.—The other articulations of the bones here being by nearly plain ſurfaces, ſcarce allow of any more motion, becauſe of the ſtrong connecting ligaments, than to yield a little, and ſo elude the force of any external power; and to render the back of the wriſt a little more flat, or the palm more hollow, on proper occaſions. The articulation of the thumb and metacarpal bones ſhall be examined afterwards.

The

The uſes of the *carpus* are to ſerve as a baſe to the hand, to protect its tendons, and to afford it a free large motion.

All the bones of the *carpus* are in a cartilaginous ſtate at the time of birth.

On account of the many tendons that paſs upon the lower end of the fore-arm and the *carpus*, and of the numerous ligaments of theſe tendons and of the bones which have lubricating liquors ſupplied to them, the pain of ſprains here is acute, the parts take long time to recover their tone, and their ſwellings are very obſtinate.

*METACARPUS** conſiſts of four bones which ſuſtain the fingers.——Each bone is long and round, with its ends larger than its body.—The upper end, which ſome call the baſe, is flat and oblong, without any conſiderable head or cavity; but it is however ſomewhat hollowed, for the articulation with the *carpus:* It is made flat and ſmooth on the ſides where theſe bones are contiguous to each other. ——Their bodies are flatted on their back-part by the tendons of the extenſors of the fingers. ——The anterior ſurface of theſe bodies is a little concave, eſpecially in their middle; along which a ſharp ridge ſtands out, which ſeparates the *muſculi interoſſei* placed on each ſide of theſe bones which are there made flat and plain by theſe muſcles.

Their lower ends are raiſed into large oblong ſmooth heads, whoſe greateſt extent is forwards from the axis of the bone.—At the

* Κτεις, προκαρπιον, σῆβος, ἀνθηρου, πτεινα, poſtbrachiale, pectus, palma, pecten.

fore-part of each ſide of the root of each of theſe heads, one or two tubercles ſtand out, for fixing the ligaments that go from one metacarpal bone to another, to preſerve them from being drawn aſunder :—Round the heads a rough ring may be remarked, for the capſular ligaments of the firſt joints of the fingers to be fixed to ; and both ſides of theſe heads are flat, by preſſing on each other.

The ſubſtance of the metacarpal bones is the ſame with that of all long bones.

At the time of birth, theſe bones are cartilaginous at both ends, which afterwards become *epiphyſes*.

The metacarpal bones are joined above to the *oſſa carpi* and to each other by nearly plain ſurfaces. Theſe connections are not fit for large motions.—The articulation of their round heads at the lower ends with the cavities of the firſt bones of the fingers, is to be taken notice of hereafter.

The concavity on the fore-part of theſe metacarpal bones, and the placing their baſes on the arched *carpus*, cauſe them to form a hollow in the palm of the hand, which is uſeful often to us.—The ſpaces between them lodge muſcles, and their ſmall motion makes them fit ſupporters for the fingers to play on.

Though the *oſſa metacarpi* ſo far agree, yet they may be diſtinguiſhed from each other by the following marks.

The *os metacarpi indicis* is generally the longeſt.—Its baſe which is articulated with the

os

os trapezoides, is hollow in the middle.—The ſmall ridge on the internal ſide of this oblong cavity is ſmaller than the one oppoſite to it, and is made flat on the ſide by the *trapezium*. —The exterior ridge is alſo ſmooth, and flat on its outſide, for its conjunction with the *os magnum*; immediately below which a ſemicircular ſmooth flat ſurface ſhews the articulation of this to the ſecond metacarpal bone.—The back part of this baſe is flatted, where the long head of the *extenſor carpi radialis* is inſerted; and its fore-part is prominent, where the tendon of the *flexor carpi radialis* is fixed.—The external ſide of the body of this bone is more hollowed by the action of muſcles, than the internal.—The tubercle at the internal root of its head is larger than the external.—Its baſe is ſo firmly fixed to the bone it is connected with, that it has no motion.

Os metacarpi medii digiti is generally the ſecond in length; but often it is as long as the former; ſometimes it is longer; and frequently it appears only to equal the firſt by the *os magnum* being farther advanced downwards than any other bone of the wriſt.—Its baſe is a broad ſuperficial cavity, ſlanting outwards; the internal poſterior angle of which is ſo prominent, as to have the appearance of a proceſs. —The internal ſide of this baſe is made plain in the ſame way as the external ſide of the former bone, while its external ſide has two hollow circular ſurfaces, for joining the third metacarpal bone, and between the ſurfaces there is a rough *foſſa*, for the adheſion of a ligament, and lodging mucilaginous glands.—The

ſhorter

ſhorter head of the *bicornis* is inſerted into the back-part of this baſe.—The two ſides of this bone are almoſt equally flatted: only the ridge on the fore-part of the body inclines outwards. —The tubercles at the fore-part of the root of the head are equal.—The motion of this bone is very little more than the firſt metacarpal one has; and therefore theſe two firmly reſiſt bodies preſſed againſt them by the thumb, or figures, or both.

Os metacarpi digiti annularis is ſhorter than the ſecond metacarpal bone.—Its baſe is ſemicircular and convex, for its conjunction with the *os unciforme*.—On its internal ſide are two ſmooth convexities, and a middle *foſſa*, adapted to the ſecond metacarpal bone.—The external ſide has a triangular ſmooth concave ſurface to join it with the fourth one. The anterior ridge of its body is ſituated more to the out than to the inſide.—The tubercles near the head are equal.—The motion of this third metacarpal bone is greater than the motion of the ſecond.

Os metacarpi minimi digiti is the ſmalleſt and ſharpeſt.—Its baſe is irregularly convex, and riſes ſlanting outwards.—Its internal ſide is exactly adapted to the third metacarpal bone. —The external has no ſmooth ſurface, becauſe it is not contiguous to any other bone; but it is prominent where the *extenſor carpi ulnaris* is inſerted.—As this *metacarpal* bone is furniſhed with a proper moving muſcle, has the plaineſt articulation, is moſt looſely connected and leaſt confined, it not only enjoys much larger motion than any of the reſt, but draws the third bone

with

with it, when the palm of the hand is to be made hollow by its advancement forwards, and by the prominence of the thumb oppoſite to it.

The *THUMB* and four *FINGERS* are each compoſed of three long bones.

The *Thumb* * is ſituated obliquely in reſpect of the fingers, neither oppoſite directly to them, nor in the ſame plane with them.—All its bones are much thicker and ſtronger in proportion to their length, than the bones of the fingers are: Which was extremely neceſſary, ſince the thumb counteracts all the fingers.

The firſt bone of the thumb has its baſe adapted to the double pulley of the *trapezium*: For, in viewing it from one ſide to the other, it appears convex in the middle; but when conſidered from behind forwards, it is concave there.—The edge at the fore-part of this baſe is produced farther than any other part: and round the back part of the baſe a rough *foſſa* may be ſeen, for the connection of the ligaments of this joint.—The body and head of this bone are of the ſame ſhape as the *oſſa metacarpi*; only that the body is ſhorter, and the head flatter, with the tubercles at the fore-part of its root larger.

The articulation of the upper end of this bone is uncommon: For though it has protuberances and depreſſions adapted to the double pulley of the *trapezium*; yet it enjoys a circular motion, as the joints do where a round head of one bone plays in the orbicular ſocket of

* Αντίχειρ, δικονδυλὸς, magnus digitus, promanus.

of another; only it is ſomewhat more confined and leſs expeditious, but ſtronger and more ſecure, than ſuch joints generally are.

This bone of children is in the ſame ſtate with the metacarpal bones.

The ſecond bone of the thumb has a large baſe formed into an oblong cavity, whoſe greateſt length is from one ſide to the other.—Round it ſeveral tubercles may be remarked, for the inſertion of ligaments.—Its body is convex, or a half round behind; but flat before, for lodging the tendon of the long flexor of the thumb, which is tied down by ligamentous ſheaths that are fixed on each ſide to the angle at the edge of this flat ſurface.—The lower end of this ſecond bone has two lateral round protuberances, and a middle cavity, whoſe greateſt extent of ſmooth ſurface is forwards.

The articulation and motion of the upper end of this ſecond bone is as ſingular as that of the former.—For its cavity being joined to the round head of the firſt bone, it would ſeem at firſt view to enjoy motion in all directions; yet, becauſe of the ſtrength of its lateral ligaments, oblong figure of the joint itſelf, and mobility of the firſt joint, it only allows flection and extenſion; and theſe are generally much confined.

The third bone of the thumb is the ſmalleſt, with a large baſe, whoſe greateſt extent is from one ſide to the other.—This baſe is formed into two cavities and a middle protuberance, to be adapted to the pulley of the former bone.——Its body is rounded behind; but

is

is flatter than in the former bone, for ſuſtaining the nail.——It is flat and rough before, by the inſertion of the *flexor tertii internodii.* ——This bone becomes gradually ſmaller, till near the lower end, where it is a little enlarged, and has an oval ſcabrous edge.

The motion of the third bone is confined to flection and extenſion.

The orderly diſpoſition of the bones of the *fingers* into three rows, has made them generally obtain the name of three *phalanges* §. ——All of them have half round convex ſurfaces, covered with an *aponeuroſis*, formed by the tendons of the *extenſors*, *lumbricales*, and *interoſſei*, and placed directly backwards, for their greater ſtrength, and their flat concave part is forwards, for taking hold more ſurely, and for lodging the tendons of the flexor muſcles.——The ligaments for keeping down theſe tendons are fixed to the angles that are between the convex and concave ſides.

The bones of the firſt *phalanx* * of the fingers anſwer to the deſcription of the ſecond bone of the thumb; only that the cavity in their baſe is not ſo oblong; nor is their motion on the metacarpal bones ſo much confined; for they can be moved laterally or circularly, but have no rotation or a very ſmall degree of it round their axis.

Both the ends of this firſt *phalanx* are in a cartilaginous ſtate at the birth; and the upper

§ Seytalidæ, internodia, ſcuticula, agmina, acies, condyli articuli.

* Προκονδυλοι.

per one is afterwards affixed in form of an *epiphyſe*.

The ſecond bone * of the fingers has its baſe formed into two lateral cavities, and a middle protuberance; while the lower end has two lateral protuberances and a middle cavity; therefore it is joined at both ends in the ſame manner, which none of the bones of the thumb are.

This bone is in the ſame condition with the former in children.

The third bone † differs nothing from the deſcription of the third bone of the thumb, excepting in the general diſtinguiſhing marks; and therefore the ſecond and third *phalanx* of the fingers enjoy only flection and extenſion.

The upper end of this third *phalanx* is a cartilage in a ripe child; and is only an *epiphyſe* after, till the full growth of the body.

All the difference of the *phalanges* of the ſeveral fingers conſiſts in their magnitude.—The bones of the middle finger ‡ being the longeſt and largeſt,—thoſe of the *fore-finger* ‖ come next to that in thickneſs, but not in length, for thoſe of the *ring-finger* ** are a little longer. The *little finger* †† has the ſmalleſt

* Κονδυλοι.

† Μετακονδυλοι, ριζωνυχια.

‡ Καταπυγων, οφακκελος, infamis, impudicus, verpus, famoſus, obſcœnus.

‖ Δεικτικος indicator, λιχανος, demonſtrativus, ſalutaris.

** Ἰατρικος, παραμεσος, δακτυλιωτης, επιβατης, annularis, medicus, cordis digitus.

†† Μοιψ, ωτίτης, auricularis, minimus.

ſmalleſt bones. Which diſpoſition is the beſt contrivance for holding the largeſt bodies; becauſe the longeſt fingers are applied to the middle largeſt periphery of ſuch ſubſtances as are of a ſpherical figure *(a)*.

The uſes of all the parts of our *ſuperior extremities* are ſo evident in the common actions of life, that it is needleſs to enumerate them here; and therefore I ſhall proceed to the laſt part of the ſkeleton. Only, leſt I ſhould ſeem to have forgot the ſmall bones at the joints of the hand, I deſire now to refer to the deſcription of them, under the common title of *ſeſamoid bones*, which I have placed after the bones of the feet.

OF THE INFERIOR EXTREMITIES.

THE *INFERIOR EXTREMITIES* depend from the *acetabula* of the *oſſa innominata*; are commonly divided into three parts, *viz.* the thigh, leg, and foot.

The *THIGH* * has only one bone; which is the longeſt of the body, and the largeſt and ſtrongeſt of any of the cylindrical bones. The ſituation of it is not perpendicular: for the lower end is inclined conſiderably inwards; ſo that the knees are almoſt contiguous, while there is a conſiderable diſtance between the thigh bones above: which is of good uſe to us, ſince ſufficient ſpace is thereby left for the external parts

(a) Galen de uſu part. lib. i. cap. 24.

* Μηρον, femen, coxa, agis, anchæ os, crus, femur.

parts of generation, the two great *cloacæ* of urine and *fæces*, and for the large thick muſcles that move the thigh inwards: and at the ſame time this ſituation of the thigh-bones renders our progreſſion quicker, ſurer, ſtreighter, and in leſs room; for had the knees been at a greater diſtance from each other, we muſt have been obliged to deſcribe ſome part of a circle with the trunk of our body in making a long ſtep, and, when one leg was raiſed from the ground, our center of gravity would have been too far from the baſe of the other, and we ſhould conſequently have been in hazard of falling; ſo that our ſteps would neither have been ſtreight nor firm; nor would it have been poſſible to walk in a narrow path, had our thigh bones been otherwiſe placed. In conſequence, however, of the weight of the body bearing ſoob liquely on the joint of the knee, by this ſituation of the thigh bones, weak rickety children become in-knee'd.

The upper end of the thigh-bone is not continued in a ſtreight line with the body of it, but is ſet off obliquely inwards and upwards, whereby the diſtance here between theſe two bones at their upper part is conſiderably increaſed.——This end is formed into a large ſmooth round head *, which is the greater portion of a ſphere unequally divided.—Towards its lower internal part a round rough ſpongy pit is obſervable, where the ſtrong ligament, commonly, but unjuſtly, called the round one, is fixed, to be extended from thence to the lower internal

* Vertebrum.

internal part of the receiving cavity, where it is conſiderably broader than near to the head of the thigh bone.——The ſmall part below the head, called the *cervix*, of the *os femoris*, has a great many large holes, into which the fibres of the ſtrong ligament, continued from the capſular, enter, and are thereby ſurely united to it; and round the root of the neck, where it riſes from the bone, a rough ridge is found, where the capſular ligament of the articulation itſelf is connected.——Below the back part of this root, the large unequal protuberance, called *trochanter-major* ‡, ſtands out; the external convex part of which is diſtinguiſhed into three different ſurfaces, whereof the one on the fore-part is ſcabrous and rough, for the inſertion of the *glutæus minimus*; the ſuperior one is ſmooth, and has the *glutæus medius* inſerted into it; and the one behind is made flat and ſmooth by the tendon of the *glutæus maximus* paſſing over it.—The upper edge of this proceſs is ſharp and pointed as its back part, where the *glutæus medius* is fixed; but forwards it is more obtuſe, and has two ſuperficial pits formed in it: Into the ſuperior of theſe, the *piriformis* is implanted; and the *obturator internus* and *gemini* are fixed into the lower one.—From the backmoſt prominent part of this great *trochanter*, a rough ridge runs backwards and downwards, into which the *quadratus* is inſerted.——In the deep hollow, at the internal upper ſide of this ridge, the *obturator externus* is implanted.—

More

‡ Γλυτὸς, rotator natis, malum granatum teſticulorum.

More internally, a conoid proceſs, called *trochanter minor* *, riſes for the inſertion of the *muſculus pſoas*, and *iliacus internus*, and the *pectineus*, is implanted into a rough hollow below its internal root.—The muſcles inſerted into theſe two proceſſes being the principal inſtruments of the rotatory motion of the thigh, have occaſioned the name of the *trochanters* to the proceſſes.—The tendons that are fixed into, or paſs over the great *trochanter*, cauſe bruiſes by falls on this part to be attended with great pain and weakneſs of the limb, which generally remain long.

The body of the *os femoris* is convex on the fore-part, and made hollow behind, by the action of the muſcles that move it and the leg, and for the conveniency of ſitting, without bearing too much on theſe muſcles; and probably the weight of the legs depending from the thighs in that poſture contributes to this curvature.——The fore-part of the thigh-bone is a little flatted above by the beginning of the *cruræus* muſcle, as it is alſo below by the ſame muſcle and the *rectus*.——Its external ſurface is likewiſe made flat below by the *vaſtus externus*, where it is ſeparated from the former by an obtuſe ridge.——The *vaſtus internus* depreſſes a little the lower part of the internal ſurface.——The poſterior concave ſurface has a ridge riſing in its middle commonly called *linea aſpera*, into which the *triceps* is inſerted, and the ſhort head of the *biceps flexor tibiæ* riſes from it.—At the upper part of it the medullary veſſels enter by a ſmall hole that

* Rotator minor.

that runs obliquely upwards.——A little above which there is a rough *foſſa* or two, where the tendon of the *glutæus maximus* is fixed.——The lower end of the *linea aſpera* divides into two, which deſcend towards each ſide.—The two *vaſti* muſcles have part of their origin from theſe ridges; and the long tendon of the *triceps* is fixed to the internal, by means of part of the *faſcia aponeurotica* of the thigh.—Near the beginning of the internal ridge, there is a diſcontinuation of the ridge, where the crural artery paſſes through the *aponeuroſis*.—Between theſe two rough lines, the bone is made flat by the large blood-veſſels and nerves which paſs upon it; and near the end of each of theſe ridges, a ſmall ſmooth protuberance may often be remarked, where the two heads of the external *gaſtrocnemius* muſcle take their riſe, and where ſeſamoid bones are ſometimes found (*a*); and from the fore-part of the internal tubercle, a ſtrong ligament is extended to the inſide of the *tibia*.

The lower end of the *os femoris* is larger than any other part of it, and is formed into a great protuberance on each ſide, called its *condyles*; between which a conſiderable cavity is found, eſpecially at the back-part, in which the crural veſſels and nerves lie immerſed in fat.——The internal condyle is longer than the external, which muſt happen from the oblique poſition of this bone, to give leſs obliquity to the leg.——Each of theſe proceſſes ſeems to be divided in its plain ſmooth ſurface. The mark of diviſion on the external

(*a*) Veſal. lib. 1. cap. 28. & 30.

nal is a notch, and on the internal a ſmall protuberance. The fore-part of this diviſion, on which the *rotula* moves, is formed like a pulley, the external ſide of which is higheſt.—Behind, there are two oblong large heads, whoſe greateſt extent is backwards, for the motion of the *tibia*; and from the rough cavity between them, but near to the baſe of the internal condyle, the ſtrong ligament commonly called the *croſs* one, has its riſe.——A little above which a rough protuberance gives inſertion to the tendon of the *triceps*.——The condyles, both on the outer and inner ſide of the knee are made flat by the muſcles paſſing along them.—On the back-part of the internal, a ſlight depreſſion is made by the tendons of the *gracilis* and *ſartorius*; and on the external ſuch another is formed by the *biceps flexor cruris*; behind which a deep *foſſa* is to be obſerved, where the *poplitæus* muſcle has its origin.—From the tubercle immediately before this cavity, a ſtrong round ligament goes out to the upper part of the *fibula*.——Round this lower end of the thigh-bone, large holes are found, into which the ligaments for the ſecurity of the joint are fixed, and blood-veſſels paſs to the internal ſubſtance of the bone.

All the proceſſes of the *femur* are cartilaginous in new born children, and afterwards become ſmall *apophyſes*, with large *epiphyſes*.

The thigh-bone being articulated above with the *acetabulum* of the *oſſa innominata*, which affords its round head a ſecure and extenſive play,

play, can be moved to every ſide; but is reſtrained in its motion outwards, by the high brims of the cavity, and by the *round* ligament; for otherwiſe the head of the bone would have been frequently thruſt out at the breach of the brims on the inſide, which allows the thigh to move conſiderably inwards. ——The body of this bone enjoys little or no rotatory motion, though the head moſt commonly moves round its own axis; becauſe the oblique progreſs of the neck and head from the bone is ſuch, that the rotatory motion of the head can only bring the body of the bone forwards and backwards: Nor is this head, as in the arm, ever capable of being brought to a ſtreight direction with its body; ſo far however as the head can move within the cavity backwards and forwards, the reſt of the bone may have a partial rotation.—— When the thigh-bone reſiſts the actions of its muſcles more than the trunk of the body can then do, as in ſtanding, theſe muſcles have their effect on the trunk, cauſing it to bend forwards, raiſing it up, inclining it to the one or the other ſide, twiſting it obliquely, *&c.* which the rolling of the *acetabula* of the *oſſa innominata* on the round heads of the thigh-bones is well fitted for.——The *os femoris* is articulated below to the *tibia* and *rotula* in the manner afterwards to be deſcribed.

The nearneſs of the ſmall neck to the round head of the thigh-bone, and its upper end being covered with very thick muſcles, make greater difficulty in diſtinguiſhing between a luxation

luxation and fracture here, than in any other part of the body.

The *LEG* * is compoſed, according to the common account, of two bones, *tibia* and *fibula*, though it ſeems to have a very good title to a third, the *rotula*; which bears a ſtrong analogy to the *olecranon* of the *ulna*, and moves always with the other two.

TIBIA†, ſo called from its reſemblance to an old muſical pipe or flute, is the long thick triangular bone, ſituated at the internal part of the leg, and continued in almoſt a ſtreight line from the thigh bone.

The upper end of the *tibia* is large, bulbous, and ſpongy, and is divided into two cavities, by a rough irregular protuberance ‡, which is hollow at its moſt prominent part, as well as before and behind. The anterior of the two ligaments that compoſe the great *croſs* one, is inſerted into the middle cavity, and the depreſſion behind receives the poſterior ligament.——The two broad cavities at the ſides of this protuberance are not equal; for the internal is oblong and deep, to receive the internal *condyle* of the thigh-bone; while the external is more ſuperficial and rounder, for the external *condyle*.——— In each of theſe two cavities of a recent ſubject, a ſemilunal cartilage is placed, which is thick at its convex edge, and becomes gradually

* Κνήμη, crus tibia.

† Προκνήμιον, ὀντικνήμιον focile majus, arundo major, canna major, canna domeſtica cruris.

‡ Διαφυσις, ἐξοχὴ νευροχονκρῶδας, tuber, tuberculum.

dually thinner towards the concave or interior edge.——The middle of each of these cartilages is broad, and the ends of them turn narrower and thinner, as they approach the middle protuberance of the *tibia*.———The thick convex edge of each cartilage is connected to the capsular and other ligaments of the articulation, but so near to their rise from the *tibia*, that the cartilages are not allowed to change place far; while the narrow ends of the cartilages becoming almost ligaments, are fixed at the insertion of the strong cross ligament into the *tibia*, and seem to have their substance united with it; therefore a circular hole is left between each cartilage and the ligament, in which the most prominent convex part of each condyle of the thigh-bone moves. ——The circumference of these cavities is rough and unequal for the firm connection of the ligaments of the joint.—Immediately below the edge of its back part, two rough flatted protuberances stand out: Into the internal, the tendon of the *semimembranosus* muscle is inserted; and a part of the cross ligament is fixed to the external.—On the outside of this last tubercle, a smooth slightly hollowed surface is formed by the action of the *poplitæus* muscle.

Below the fore-part of the upper end of the *tibia*, a considerable rough protuberance * rises, to which the strong tendinous ligament of the *rotula* is fixed.—On the internal side of this, there is a broad scabrous slightly hol-

* Ἀντίκνημιον, anterior tuber.

lowed ſurface, to which the internal long ligament of the joint, the *aponeuroſis* of the *vaſtus internus*, and the tendons of the *ſeminervoſus*, *gracilis*, and *ſartorius*, are fixed.—The loweſt part of this ſurface is therefore the place where the *tibia* ought to be ſawed thro' in an amputation, ſo as not to have too long and troubleſome a ſtump, and, at the ſame time, to preſerve its motions, by ſaving the proper muſcles.—Below the external edge of the upper end of the *tibia*, there is a circular flat ſurface, covered in a recent ſubject with cartilage, for the articulation of the *fibula*; ——between which and the anterior knob, there is a rough hollow from which the *tibialis anticus*, and *extenſor digitorum longus*, take their origin.—From the ſmooth flat ſurface, a ridge runs obliquely downwards and inwards, to give riſe to part of the *ſolæus*, *tibialis poſticus*, and *flexor digitorum longus*, and inſertion to the *aponeuroſis* of the *ſemimembranoſus* which covers the *poplitæus*, and to ſome of the external fibres of this laſt named muſcle.—At the inſide of this ridge an oblique plain ſurface is left, where the greateſt part of the *muſculus poplitæus* is inſerted.—The remaining body of the *tibia* is triangular.—— The anterior angle is very ſhort, and is commonly called the *ſpine* or *ſhin*†. This ridge is not ſtreight; but turns firſt inwards, then outwards, and laſtly inwards again.——The plain internal ſide is ſmooth and equal, being little ſubjected to the actions of muſcles; but the

† Ακανθα, ſpina, crea. linea prima tibiæ. angulus acutus.

the external ſide is hollowed above by the *tibialis anticus*, and below by the *extenſor digitorum longus* and *extenſor pollicis longus*. ——The two angles behind theſe ſides are rounded by the action of the muſcles;—the poſterior ſide comprehended between them is not ſo broad as thoſe already mentioned, but is more oblique and flatted by the action of the *tibialis poſticus* and *flexor digitorum longus*.—Some way above the middle of the bone, the internal angle terminates, and the bone is made round by the preſſure of the *muſculus ſolæus*.—Near to this, the paſſage of the medullary veſſels is ſeen ſlanting obliquely downwards.

The lower end of the *tibia* is made hollow, but ſo as a ſmall protuberance riſes in the middle.——The internal ſide of this cavity, which is ſmooth, and, in a recent ſubject, is covered with cartilage, is produced into a conſiderable proceſs, commonly named *malleolus internus* *; the point of which is divided by a notch, and from it ligaments are ſent out to the foot.—We ought to obſerve here, that this internal *malleolus* is ſituated more forwards than the internal condyle of the upper end of this bone; which is neceſſary to be remembered in reducing a fracture of the leg *(a)*.——The external ſide of this end of the *tibia* has a rough irregular ſemilunar ca-

* Σφυρὸν, πεσον, talus, clavicula, clavilla, interior, clavilla domeſtica.

(a) Winſlow, Expoſition anatomique, des os ſecs. ſect. 865.

vity formed in it, for receiving the lower end of the *fibula*.—The poſterior ſide has two lateral grooves, and a ſmall middle protuberance. In the internal depreſſion, the tendons of the *muſculus tibialis poſticus* and *flexor digitorum longus* are lodged; and in the external, the tendon of the *flexor longus pollicis* plays. —From the middle protuberance, ligamentous ſheaths go out, for tying down theſe tendons.

The articulations and motions of the *tibia* ſhall be explained, after all the three bones of the leg are deſcribed.

Both the ends of the *tibia* are cartilages at birth, and become afterwards *epiphyſes*.

*FIBULA** is the ſmall long bone, placed on the outſide of the leg, oppoſite to the external angle of the *tibia*; the ſhape of it is irregularly triangular.

The head of the *fibula* has a ſuperficial circular cavity formed on its inſide, which, in a recent ſubject, is covered with a cartilage, but ſo cloſely connected to the *tibia* by ligaments, as to allow only a ſmall motion backwards and forwards.—This head is protuberant and rough on its outſide, where a ſtrong round ligament and the *muſculus biceps* are inſerted; and, below the back part of its internal ſide, a tubercle may be remarked, that gives riſe to the ſtrong tendinous part of the *ſolæus* muſcle.

The

* Παρακνήμιον perone, ſocile minus, arundo minor, canna minor cruris, ſura, radius.

The body of this bone is a little crooked inwards and backwards, which figure is owing to the actions of the muſcles; but is ſtill further increaſed by nurſes, who often hold children careleſsly by the legs.—The ſharpeſt angle of the *fibula* is forwards, on each ſide of which the bone is conſiderably but unequally depreſſed by the bellies of the ſeveral muſcles that riſe from, or act upon it; and, in old people, theſe muſcles make diſtinct ſinuoſities for themſelves.—The external ſurface of the *fibula* is depreſſed obliquely from above downwards and backwards, by the two *peronæi*.——Its internal ſurface is unequally divided into two narrow longitudinal planes, by an oblique ridge extended from the upper part of the anterior angle, to join with the lower end of the internal angle. To this ridge the ligament ſtretched between the two bones of the leg is connected.—The anterior of the two planes is very narrow above, where the *extenſor longus digitorum* and *extenſor longus pollicis* ariſe from it; but is broader below, where it has the print of the *nonus Veſalii*.——The poſterior plane is broad and hollow, giving origin to the larger ſhare of the *tibialis poſticus*.———The internal angle of this bone has a tendinous membrane fixed to it, from which fibres of the *flexor digitorum longus* take their riſe.——The poſterior ſurface of the *fibula* is the plaineſt and ſmootheſt, but is made flat above by the *ſolæus*, and is hollowed below by the *flexor pollicis longus*.———In the middle of

this ſurface the canal for the medullary veſſels may be ſeen ſlanting downwards.

I have taken particular notice of the entry and direction of the medullary veſſels of the large bones of the extremities *(a)*; becauſe, in ſeveral chirurgical caſes, a ſurgeon, who is ignorant of this, may do miſchief to his patient. Thus, for example, if theſe veſſels are opened very near to their entry into the bone, or while they are in the oblique paſſage though it, an obſtinate hæmorrhagy may enſue: For the arteries being connected to the bony paſſage, ſtyptics, and other like corrugators, are vainly applied: compreſſing inſtruments can do no ſervice, and ligatures cannot be employed.—There ſeems to be a particular deſign in the contrivance of theſe canals; thoſe in the *os humeri*, *tibia*, and *fibula*, running obliquely downwards from their external entry; whereas in the *radius*, *ulna*, and *os femoris*, they ſlant upwards, whereby the arteries and nerves which are ſent into theſe three laſt bones, muſt ſuffer a conſiderable reflection before they come at the *cancelli*. The reaſon of this diverſity may perhaps be, that the arteries which are ſo ſmall within the bones as to have no ſtrong contractile propelling force in their coats, and where they are not aſſiſted by the action of any moving neighbouring organ, ſhould have, at leaſt in their paſſage thro' the bone, a favourable deſcent for their liquids: Which, it is evident, they have in the deſcending oblique paſſages formed for them in the firſt claſs of bones, to wit, the

os

(a) Havers, Oſteolog. nov. diſc. 1. p. 59.

os humeri, *tibia*, and fibula, which are generally depending; and they alſo moſt frequently acquire the like advantage in the *radius*, *ulna*, and *os femoris*, becauſe the hand, in the moſt natural poſture, is higher than the elbow; and when we ſit or lie, the lower end of the thigh bone comes to be at leaſt as high raiſed as the upper. In ſtanding and walking, or when the arms are moved, the blood muſt indeed aſcend as it paſſes through the bones of the fore-arm and thigh; but the preſſure of the muſcles, then in action, on the veſſels, before they enter the bones, is ſufficient to compenſate the diſadvantage of their courſe. This reaſoning ſeems to be ſtill enforced, by obſerving, that this paſſage is always nearer the upper than the lower ends of theſe bones.

The lower end of the *fibula* is extended into a ſpongy oblong head, on the inſide of which is a convex, irregular, and frequently a ſcabrous ſurface, that is received by the external hollow of the *tibia*, and ſo firmly joined to it by a very thin intermediate cartilage and ſtrong ligaments, that it ſcarce can move.—Below this, the *fibula* is ſtretched out into a coronoid proceſs, that is ſmooth, covered with cartilage on its internal ſide, and is there contiguous to the outſide of the firſt bone of the foot, the *aſtragalus*, to ſecure the articulation. This proceſs, named *malleolus externus*, being ſituated farther back than the internal *malleolus*, and in an oblique direction, obliges us naturally to turn the fore-part of the foot

outwards (*a*). At the lower internal part of this proceſs, a ſpongy cavity for mucilaginous glands may be remarked; from its point ligaments are extended to the *aſtragalus*, *os calcis*, and *os naviculare*, bones of the foot; and from its inſide ſhort ſtrong ones go out to the *aſtragalus*. On the back part of it a ſinuoſity is made by the tendons of the *peronæi* muſcles. When the ligament extended over theſe tendons from the one ſide of the depreſſion to the other is broke, ſtretched too much, or made weak by a ſprain, the tendons frequently ſtart forwards to the outſide of the *fibula*.

The conjunction of the upper end of the *fibula* with the *tibia* is by plain ſurfaces tipped with cartilage, and at its lower end the cartilage ſeems to glue the two bones together, not, however, ſo firmly in young people, but that the motion at the other end of ſuch a long *radius* is very obſervable.—In old ſubjects I often ſee the two bones of the leg grown together at their lower ends.

The principal uſe of this bone is to afford origin and inſertion to muſcles; the direction of which may be a little altered on proper occaſions, by its upper part ſhuffling backwards and forwards.—It likewiſe helps to make the articulation of the foot more ſecure and firm.—The ends of the *tibia* and *fibula* being larger than their middle, a ſpace is here left, which is filled up with ſuch another ligament as I deſcribed extended between the bones of the

(*a*) Winſlow, Memoires de l'acad. des ſciences, 1722.

the fore-arm; and which is alſo diſcontinued at its upper part, where the *tibialis anticus* immediately adheres to the *ſolæus* and *tibialis poſticus*; but every where elſe it gives origin to muſcular fibres (*a*).

But the ends of this bone are cartilaginous in a ripe child, and aſſume the form of *appendices* before they are united to its body.

ROTULA † is the ſmall flat bone ſituated at the fore-part of the joint of the knee.—— Its ſhape reſembles the common figure of the heart with its point downwards.—The anterior convex ſurface of the *rotula* is pierced by a great number of holes, into which fibres of the ſtrong ligament that is ſpread over it enter.——Behind, its ſurface is ſmooth, covered with cartilage, and divided by a middle convex ridge into two cavities, of which the external is largeſt; and both are exactly adapted to the pulley of the *os femoris*, on which they are placed in the moſt ordinary unſtraining poſtures of the leg; but when the leg is much bended, the *rotula* deſcends far down on the condyles; and when the leg is fully extended, the *rotula* riſes higher, in its upper part, than the pulley of the thigh-bone.——The plain ſmooth ſurface is ſurrounded by a rough prominent edge, to which the capſular ligament adheres.——Below, the point of the bone is ſcabrous, where the ſtrong tendinous ligament from the tubercle of the *tibia* is fixed—The

(*a*) Weitbrecht, Syndeſmolog. p. 156.

* Επιμυλις, μυλακρις, κόγχος, επιγονατις, πλακουντεδρον patella, mola, genu, ſcutiforme os, cartilaginoſum, diſciforme, oculus genu.

upper horizontal part of this bone is flatted and unequal, where the tendons of the extenſors of the leg are inſerted.

The ſubſtance of the *rotula* is cellular, with very thin external firm plates: But then theſe *cells* are ſo ſmall, and ſuch a quantity of bone is employed in their formation, that ſcarce any bone of its bulk is ſo ſtrong. Beſides, it is covered all over with a thick ligament, (as it was obſerved, that this ſort of bones generally is) to connect its ſubſtance, and is moveable to one ſide or other; therefore is ſufficiently ſtrong to reſiſt the ordinary actions of the large muſcles that are inſerted into it, or any common external force applied to it; while a fixed proceſs, ſuch as the *olecranon*, would not have been ſufficient to bear the whole weight of our bodies, which frequently falls on it, and would have hindered the rotatory motion of the leg. Notwithſtanding theſe precautions to preſerve this bone from ſuch injuries, yet I have ſeen a tranſverſe fracture in it, when, by the report of the patient, and of the people about him, and by the want of ſwelling, diſcolouring, or other mark of bruiſe or contuſion, it was plain the bone was broken by the violent ſtraining effort of the muſcles (*a*). Though my patient recovered the uſe of the joint of the knee, yet I think it reaſonable to believe, that this ſort of fracture is commonly attended with difficulty of motion, after the broken parts of the *rotula* are reunited; becauſe the callous matter probably extends itſelf into the cavity of the joint, where it either grows to ſome of the

(*a*) See Ruyſch. Obſerv. anat. chirurg. obſ. 3.

the parts, or makes such an inequality on the surface of this bone, as does not allow it to perform the necessary motions on the condyles of the *femur* (*a*).

At the ordinary time of birth, the *rotula* is entirely cartilaginous, and scarcely assumes a bony nature so soon as most *epiphyses* do.

The parts which constitute the joint of the knee being now described, let us examine what are its motions, and how performed.—The two principal motions are flection and extension.———In the former of these, the leg may be brought to a very acute angle with the thigh, by the condyles of the thigh-bones being round and made smooth far backwards. In performing this, the *rotula* is pulled down by the *tibia*.———When the leg is to be extended, the *rotula* is drawn upwards, consequently the *tibia* forwards, by the *extensor* muscles; which, by means of the protuberant joint, and of this thick bone with its ligament, have in effect the chord, with which they act, fixed to the *tibia* at a considerable angle, therefore act with advantage; but are restrained from pulling the leg farther than to a streight line with the thigh, by the posterior part of the *cross* ligament, that the body might be supported by a firm perpendicular column: For at this time the thigh and leg are as little moveable in a rotatory way, or to either side, as if they were one continued bone.—But when the joint is a little bended, the *rotula* is not tightly braced, and the posterior ligament is relaxed; therefore this bone may be moved a little to either side, or with a small rotation in the superficial cavities

(*a*) Pare, liv. 15. cap. 22.

cavities of the *tibia*; which is done by the motion of the external cavity backwards and forwards, the internal ſerving as a ſort of axis (*a*). Seeing then one part of the *croſs* ligament is ſituated perpendicularly, and the poſterior part is ſtretched obliquely from the internal condyle of the thigh outwards, that poſterior part of the *croſs* ligament prevents the leg's being turned at all inwards; but it could not hinder it from turning outwards almoſt round, was not that motion confined by the lateral ligaments of this joint, which can yield little. This rotation of the leg outwards is of good advantage to us in croſſing our legs, and turning our feet outwards, on ſeveral neceſſary occaſions; tho' it is altogether fit this motion ſhould not be very large, to prevent frequent luxations here. ——While all theſe motions are performing, the part of the *tibia* that moves immediately on the condyles is only ſo much as is within the cartilaginous rings, which, by the thickneſs on their outſides, make the cavities of the *tibia* more horizontal, by raiſing their external ſide where the ſurface of the *tibia* ſlants downwards. By this means the motions of this joint are more equal and ſteady than otherwiſe they would have been. The cartilages being capable of changing a little their ſituation, are fit for doing this good office in the different motions and poſtures of the member, and likewiſe contribute to make the motions larger and quicker.

On account of the very large ſurface of the bones forming the joint of the knee, and the many

(*a*) Winſlow, Expoſition anatomique du corps humain, traite des os ſecs, § 976.

many ſtrong ligaments connecting them, luxations ſeldom happen here. But theſe very ligaments, the *aponeuroſis* paſſing over this joint, the quantity of fat and mucilaginous glands neceſſary for lubricating it, make it more ſubject to *white-ſwellings*, dropſies, and ſuch other diſorders, than any other joint of the body.

The *FOOT* is divided, as well as the hand, into three parts, *viz. tarſus*, *metatarſus*, and *toes:* In the deſcription of which, the ſeveral ſurfaces ſhall be named, according to their natural ſituation, *viz.* the *broad* of the foot, ſhall be called ſuperior; the ſole, inferior; the ſide on which the great toe is, internal; but where the little toe is, external.

The *tarſus* † conſiſts of ſeven ſpongy bones; to wit, the *aſtragalus*, *os calcis*, *naviculare*, *cuboides*, *cuneiforme externum*, *cuneiforme medium*, and *cuneiforme internum*.

The *aſtragalus* is the uppermoſt of theſe bones.—The *os calcis* is below the *aſtragalus*, and is conſiderably prominent backwards beyond the other bones to form the heel.——The *os naviculare* is in the middle of the internal ſide of the *tarſus*.——The *os cuboides* is the moſt external of the row of four bones at its fore-part.——The *os cuneiforme externum* is placed at the inſide of the *cuboid*.——The *cuneiforme medium* is between the *external* and *internal cuneiform* bones, and the *internal cuneiform* is put at the internal ſide of the foot.

That the deſcription of theſe bones may not be

† Raſſetta.

be immoderately ſwelled with repetition, I deſire, once for all, to obſerve, That wherever a ridge is mentioned; without a particular uſe aſſigned, a ligament is underſtood to be fixed to it; or where a ſpongy rough cavity, depreſſion, or *foſſa* is remarked, without naming its uſe, a ligament is inſerted, and mucilaginous glands are lodged: For ſuch will occur in the detail of each of theſe bones.

The upper part of the *aſtragalus* † is formed into a large ſmooth head ‡, which is ſlightly hollowed in the middle; and therefore reſembles a ſuperficial pulley, by which it is fitted to the lower end of the *tibia*.—The internal ſide of this head is flat and ſmooth, to play on the internal *malleolus*.———The external ſide has alſo ſuch a ſurface, but larger, for its articulation with the external *malleolus*.—Round the baſe of this head there is a rough *foſſa*; and, immediately before the head, as alſo below its internal ſmooth ſurface, we find a conſiderable rough cavity.

The lower ſurface of the *aſtragalus* is divided by an irregular deep rough *foſſa*; which at its internal end is narrow, but gradually widens, as it ſtretches, obliquely outwards and forwards.—The ſmooth ſurface, covered with cartilage, behind this *foſſa*, is large, oblong, extended in the ſame oblique ſituation with the *foſſa*, and concave, for its conjunction with the *os calcis*.—The back part of the edge of this cavity is produced into two ſharp pointed rough

† Ἄστρος, talus, baliſtæ os, malleolus, chaib, quatrio, os teſſaræ, claviculæ, nuciforme.

‡ Τετράωρος.

rough proceſſes, between which is a depreſſion made by the tendon of the *flexor pollicis longus*. The lower ſurface before the *foſſa* is convex, and compoſed of three diſtinct ſmooth planes. The long one behind, and the exterior or ſhorteſt, are articulated with the heel bone; while the internal, which is the moſt convex of the three, reſts and moves upon a cartilaginous ligament, that is continued from the *calcaneum* to the *os ſcaphoides*. Without which ligament, the *aſtragalus* could not be ſuſtained, but would be preſſed out of its place by the great weight it ſupports, and the other bones of the *tarſus* would be ſeparated. Nor would a bone be fit here, becauſe it muſt have been thicker than could conveniently be allowed; otherwiſe it would break, and would not prove ſuch an eaſy bending baſe, to leſſen the ſhock which is given to the body in leaping, running, &c.

The fore-part of this bone is formed into a convex oblong ſmooth head, called by ſome its proceſs, which is received by the *os naviculare*. Round the root of this head, eſpecially on the upper ſurface, a rough *foſſa* may be remarked.

The *aſtragalus* is articulated above to the *tibia* and *fibula*, which together form one cavity. Though in this articulation, the bones have prominencies and cavities ſo ſmall, as might allow motions in all directions; yet the flection and extenſion are the moſt conſiderable, the other motions being confined by the *malleoli*, and by the ſtrong ligaments which go out from the points of theſe proceſſes to the *aſtragalus* and *os calcis*.—When the foot is bended, ſo far

as

as it is commonly when we ſtand, no lateral or rotatory motion is allowed in this joint; for then the head of the *aſtragalus* is ſunk deep between the *malleoli*, and the ligaments are tenſe; but when the foot is extended, the *aſtragalus* can move a little to either ſide, and with a ſmall rotation. By this contrivance the foot is firm, when the weight of the body is to be ſupported on it; and when a foot is raiſed, we are at liberty to direct it more exactly to the place we intend next to ſtep upon.——The *aſtragalus* is joined below, to the *os calcis*; and before, to the *os naviculare*, in the manner to be explained, when theſe bones are deſcribed.

A conſiderable ſhare of this bone is oſſified in a new born infant.

Calcaneum * is the largeſt bone of the ſeven.——Behind, it is formed into a large knob, commonly called the *heel*: The ſurface of which is rough behind, where the *tendo Achillis* is inſerted into it; and above, it is hollow and ſpongy. Farther forwards, on the upper ſurface of the *calcaneum*, there is an irregular oblong ſmooth convexity, adapted to the concavity at the back part of the *aſtragalus*: And beyond this a narrow *foſſa* is ſeen, which divides it from two ſmall concave ſmooth ſurfaces, that are joined to the fore-part of the *aſtragalus*.—Behind the poſterior of theſe ſmooth ſurfaces, which is the largeſt, a ſmall ſinuoſity is made by the tendon of the *flexor digitorum longus*; at the fore-part of which a ſmall rough protuberance

* Os calcis, πτέρνα, calcar pedis.

tuberance appears, that gives rise to the *musculus extensor digitorum brevis*.

The external side of this bone is flat, with a superficial *fossa* running horizontally, in which the tendon of the *musculus peronæus longus* is lodged.——The internal side of the heel-bone is hollowed, for lodging the origin of the *massa cornea Jac. Sylvii*, and for the safe passage of tendons, nerves, and arteries. ——Under the side of the internal smooth concavity, a particular groove is made by the tendon of the *flexor pollicis longus*; and from the thin protuberance on this internal side, the cartilaginous ligament that supports the *astragalus*, goes out to the *os naviculare*; on which ligament, and on the edge of this bone to which it is fixed, the groove is formed for the tendon of the *flexor digitorum profundus*.

The lower surface of this bone is pressed flat at the back part, by the weight of our bodies; and immediately before this plane, there are two tubercles, from the internal of which the *musculus abductor pollicis*, *flexor digitorum sublimis*, as also part of the *aponeurosis plantaris*, and of the *abductor minimi digiti*, have their origin; and the other part of the *abductor minimi digiti* and *aponeurosis plantaris* rises from the external.—Before these protuberances this bone is concave, for lodging the flexor muscles; and at its fore-part we may observe a rough depression, from which, and a tubercle behind it, the ligament goes out that prevents this bone to be separated from the *os cuboides*.

The fore-part of the *os calcis* is formed into an oblong pulley like smooth surface, which is circular

circular at its upper external end, but is pointed below. This ſmooth ſurface is fitted to the *os cuboides*.

Though the ſurface by which the *aſtragalus* and *os calcis* are articulated, ſeem fit enough for motion; yet the very ſtrong ligaments by which theſe bones are connected, prevent it, and render this principal part of our baſe, which reſts on the ground, *to wit*, the *os calcis*, firm.

A large ſhare of the heel bone is oſſified at the ordinary time of birth, and the large knob appears afterwards in form of an *epiphyſe*.

Os naviculare *, is ſomewhat circular.——It is formed into an oblong concavity behind for receiving the anterior head of the *aſtragalus*.———On the upper ſurface there is a rough *foſſa*.————Below, the *os naviculare* is very unequal and rough; but hollow for the ſafety of the muſcles.———On its inſide a large knob riſes out, from which the *abductor pollicis* takes in part its origin, the tendon of the *tibialis poſticus* is inſerted into it, and to it two remarkable ligaments are fixed; the firſt is the ſtrong one, formerly mentioned, which ſupports the *aſtragalus*; the ſecond is ſtretched from this bone obliquely croſs the foot, to the metatarſal bones of the middle toe, and of the toe next to the little one.————On the outſide of the *os naviculare* there is a ſemicircular ſmooth ſurface, where it is joined to the *os cuboides*.——The fore-part of this bone is all covered

* Σκαφοειδὴς, os cymbæ.

covered with cartilage, and is divided into three ſmooth planes, fitted to the three *oſſa cuneiformia*.

The *os naviculare* and *aſtragalus* are joined as a ball and ſocket, and the *naviculare* moves in all directions in turning the toes inwards, or in raiſing or depreſſing either ſide of the foot, though the motions are greatly reſtrained by the ligaments which connect this to the other bones of the *tarſus*.——A weakneſs of theſe ligaments cauſes ſometimes an unnatural turn of the fore-part of the foot inwards.

The *os naviculare* is wholely cartilaginous in a new born infant.

OS CUBOIDES * is a very irregular cube.——Behind, it is formed into an oblong unequal cavity, adapted to the fore-part of the *os calcis*.—On its internal ſide, there is a ſmall ſemicircular ſmooth cavity, to join the *os naviculare*.—Immediately before which, an oblong ſmooth plane is made by the *os cuneiforme externum*.——Below this the bone is hollow and rough.—On the internal ſide of the lower ſurface, a round protuberance and *foſſa* are found, where the *muſculus abductor pollicis* has its origin. On the external ſide of this ſame ſurface, there is a round knob, covered with cartilage; immediately before which, a ſmooth *foſſa* may be obſerved, in which the tendon of the *peronæus primus* runs obliquely croſs the foot; and on the knob, the thin flat cartilage

* Πολυμορφον, cubiforme, quadratum, grandinoſum, varium, teſſaræ, multiforme.

cartilage proper to this muſcle plays; in place of which ſometimes a bone is found:—More externally than the knob, a rough hollow is made, for the ſtrong ligaments ſtretched betwixt this bone and the *os calcis*.—Before, the ſurface of the *os cuboides* is flat, ſmooth, and ſlightly divided into two planes, for ſuſtaining the *os metatarſi* of the little toe, and of the toe next to it.

The form of the back part of the *os cuboides*, and the ligaments connecting the joint there with the *os calcis*, both concur in allowing little motion in this part.

The oſſification of this bone is ſcarcely begun at the birth.

*Os cuneiforme externum**, if we regard its ſituation or *medium* by its bulk, is much of the ſhape of a wedge, being broad and flat above, with long ſides running obliquely downwards, and terminating in a ſharp edge.—The upper ſurface of this bone is an oblong ſquare.—The one behind is nearly a triangle, but not compleat at the inferior angle, and is joined to the *os naviculare*.—The external ſide is an oblong ſquare divided as it were by a diagonal; the upper half of it is ſmooth, for its conjunction with the *os cuboides*: The other is a ſcabrous hollow, and in its ſuperior anterior angle a ſmall ſmooth impreſſion is made by the *os metatarſi* of the toe next to the little one.—The internal ſide of this bone is alſo quadrangular, with the fore-part of its edge made flat and ſmooth by the *os metatarſi* of the toe next to

* Chalcoideum externum.

to the great one, and the back part is alſo flat and ſmooth where the *os cuneiforme medium* is contiguous to it.—The fore part of this bone is an oblong triangle, for ſuſtaining the *os metatarſi* of the middle toe.

Os cuneiforme medium, or *minimum*, is ſtill more exactly the ſhape of a wedge than the former.—Its upper part is ſquare;—its internal ſide has a flat ſmooth ſurface above and behind, for its conjunction with the following bone; with a ſmall rough *foſſa* below; and a conſiderable ſhare of it is rough and hollow.—The external ſide is ſmooth and a little hollowed, where it is contiguous to the laſt deſcribed bone.—Behind, this bone is triangular, where it is articulated with the *os naviculare*; and it is alſo triangular at its fore-part, where it is contiguous to the *os metatarſi* of the toe next to the great one.

Os cuneiforme maximum or *internum*, differs from the two former in its ſituation, which is more oblique than theirs.—Beſides, its broad thick part is placed below, and the ſmall thin point is above and outwards; while its under broad ſurface is concave, for allowing a ſafe paſſage to the flexors of the great toe.—The ſurface of this *os cuneiforme* behind, where it is joined to the *os naviculare*, is hollow, ſmooth, and of a circular figure below, but pointed above.—The external ſide conſiſts of two ſmooth and flat ſurfaces, whoſe direction is nearly at right angles with each other. With the poſterior, that runs obliquely from below forwards and upwards, the *os cuneiforme minimum* is joined; and with the anterior, whoſe direction is longitudinal

longitudinal, the *os metatarsi* of the toe next to the great one is connected.——The forepart of this bone is semilunar, but flat and smooth, for sustaining the *os metatarsi* of the great toe.——The internal side is scabrous, with two remarkable tubercles below, from which the *musculus abductor pollicis* rises, and the *tibialis anticus* is inserted into its upper part.

The three cuneiform bones are all so secured by ligaments, that very little motion is allowed in any of them, and they are cartilaginous in a *fœtus* of nine months.

These seven bones of the *tarsus*, when joined, are convex above, and leave a concavity below, for lodging safely the several muscles, tendons, vessels, and nerves that lie in the sole of the foot.--In the recent subject, their upper and lower surfaces are covered with strong ligaments which adhere firmly to them, and all the bones are so tightly connected by these and the other ligaments, which are fixed to the rough ridges and *fossæ* mentioned in the preceding description of the particular bones, that, notwithstanding the many surfaces covered with cartilage, some of which are of the form of the very moveable articulations, no more motion is here allowed, than only to prevent too great a shock of the fabric of the body in walking, leaping, &c. by falling on too solid a base; which, if it was one continued bone, would likewise be much more liable to be broken: and, in order to make our foot accommodate itself to the surfaces we tread on, by becoming more or less hollow, or by raising or depressing either side

ſide of it, as might be judged by what was ſaid of the particular bones.

Sprains here occaſion, as in the wriſt, great pain and obſtinate tumours, which too often cauſe carious bones.

METATARSUS * is compoſed of five bones, which, in their general characters, agree with the metacarpal bones; but may be diſtinguiſhed from them by the following marks: 1. They are longer, thicker, and ſtronger. 2. Their anterior round ends are not ſo broad, and are leſs in proportion to their baſes. 3. Their bodies are ſharper above and flatter on the ſides, with their inferior ridge inclined more to the outſide. 4. The tubercles at the lower parts of the round head are larger.

The firſt or internal metatarſal bone is eaſily diſtinguiſhed from the reſt by its thickneſs. —The one next to it is the longeſt, and with its ſharp edge almoſt perpendicular.—The others are ſhorter and more oblique, as their ſituation is more external. Which general remarks, with the deſcription I am now to give of each, may teach us to diſtinguiſh them from each other.

Os metatarſi pollicis is by far the thickeſt and ſtrongeſt, as having much the greateſt weight to ſuſtain. Its baſe is oblong, irregularly concave, and of a ſemilunar figure, to be adapted to the *os cuneiforme maximum.*—The inferior edge of this baſe is a little prominent and rough,

* Στῆθος, πεδίον, planta, planum, veſtigium, ſolium, pectus, praecordium, pectuſculum.

rough, where the tendon of the *peronæus primus* muſcle is inſerted.—On its outſide an oblique circular depreſſion is made by the ſecond metatarſal bone.—Its round head has generally on its fore-part a middle ridge, and two oblong cavities, for the *oſſa ſeſamoidea*; and on the external ſide a depreſſion is made by the following bone.

Os metatarſi of the ſecond toe, is the longeſt of the five, with a triangular baſe ſupported by the *os cuneiforme medium* and the external ſide produced into a proceſs; the end of which is an oblique ſmooth plane, joined to the *os cuneiforme externum*.—Near the internal edge of the baſe, this bone has two ſmall depreſſions, made by the *os cuneiforme maximum*, between which is a rough cavity.—Farther forwards we may obſerve a ſmooth protuberance, which is joined to the foregoing bone.—On the outſide of the baſe are two oblong ſmooth ſurfaces, for its articulation with the following bone; the ſuperior ſmooth ſurface being extended longitudinally, and the inferior, perpendicularly; between which there is a rough *foſſa*.

Os metatarſi of the middle toe, is the ſecond in length.—Its baſe, ſupported by the *os cuneiforme externum*, is triangular, but ſlanting outwards, where it ends in a ſharp pointed little proceſs; and the angle below is not compleated.

The internal ſide of this baſe is adapted to the preceding bone; and the external ſide has alſo two ſmooth ſurfaces covered with cartilage, but of a different figure; for the upper

per one is concave, and, being round behind, turns ſmaller as it advances forwards; and the lower ſurface is little, ſmooth, convex, and very near the edge of the baſe.

Os metatarſi of the fourth toe, is near as long as the former, with a triangular ſlanting baſe joined to the *os cuboides*, and made round at its external angle, having one hollow ſmooth ſurface on the outſide, where it is preſſed upon by the following bone, and two on the internal ſide, correſponding to the former bone; behind which is a long narrow ſurface impreſſed by the *os cuneiforme externum*.

Os metatarſi of the little toe, is the ſhorteſt, ſituated with its two flat ſides above and below, and with the ridges laterally.——The baſe of it, part of which reſts on the *os cuboides*, is very large, tuberous, and produced into a long-pointed proceſs externally, where part of the *abductor minimi digiti* is fixed; and into its upper part the *peronæus ſecundus* is inſerted.—— Its inſide has a flat conoidal ſurface, where it is contiguous to the preceding bone.

When we ſtand, the fore-ends of theſe metatarſal bones, and the *os calcis*, are our only ſupporters; and therefore it is neceſſary they ſhould be ſtrong, and ſhould have a confined motion.

The bones of the *TOES* are much a-kin to thoſe of the thumb and fingers: particularly the two of the great toe are preciſely formed as the two laſt of the thumb; only their poſition, in reſpect of the other toes, is not oblique; and they are proportionally much ſtronger, becauſe they are ſubjected to a greater

force: for they ſuſtain the force with which our bodies are puſhed forwards by the foot behind at every ſtep we make; and on them principally the weight of the body is ſupported, when we are raiſed on our tiptoes.

The three bones in each of the other four toes, compared to thoſe of the fingers, differ from them in theſe particulars.——They are leſs, and ſmaller in proportion to their lengths:——Their baſes are much larger than their anterior ends: Their bodies are more narrow above and below, and flatter on the ſides.—The firſt *phalanx* is proportionally much longer than the bones of the ſecond and third, which are very ſhort.

Of the four, the toe next to the great one, has the largeſt bones in all dimenſions, and more externally the toes are leſs.—The little toe, and frequently that next to it, have the ſecond and third bones intimately united into one: which may be owing to their little motion, and the great preſſure they are ſubjected to.

The toes are of good uſe to us in walking; for, when the ſole is raiſed, they bring our body, with its center of gravity, perpendicular to the advanced foot.

The bones of the *metatarſus* and toes, are in the ſame condition in children as thoſe of the *metacarpus* and fingers.

The only bones now remaining to complete the deſcription of the ſkeleton, are the ſmall ones, which are found at the joints of the fingers and toes, and in ſome other parts, called

OSSA

OSSA SESAMOIDEA, which are of very different figures and ſizes, though they are generally ſaid to reſemble the ſeed of the *ſeſamum*.——They ſeem to me nothing elſe than the ligaments of the articulations or the firm tendons of ſtrong muſcles, or both, become bony, by the compreſſion which they ſuffer. Thus the *ſeſamoid* bones at the beginning of the *gaſtrocnemii* muſcles, are evidently compoſed of the tendinous fibres only.—Theſe, at the firſt joint of the great toe, are as plainly the ſame continued ſubſtance with the ligaments and the tendons of the *adductor*, *flexor*, *brevis*, and *abductor*.———That which is ſometimes double at the ſecond joint of that toe, is part of the capſular ligament; and if we enumerate the other *ſeſamoid* bones that are at any time found, we may obſerve all of them formed in this manner.—Their number, figure, ſituation, and magnitude, are ſo uncertain, that it were in vain to inſiſt on the differences of each; and therefore I ſhall only in general remark,

1. That where-ever the tendons and ligaments are firmeſt, the actions of the muſcles ſtrongeſt, and the compreſſion greateſt, there ſuch bones are moſt commonly found.

2. That, *cæteris paribus*, the older the ſubject is in which they are ſought, their number is greater, and their ſize is larger.

3. The more labour any perſon is inured to, he has, *cæteris paribus*, the moſt numerous and largeſt *oſſa ſeſamoidea*.

However, as the two at the firſt joint of the great toe are much larger than any other, are

early formed, and are ſeldom wanting in an adult, we may judge, that beſides the more forcible cauſe of their formation, there ſhould alſo be ſome particular advantage neceſſary at this place, rather than elſewhere, which may poſſibly be, to allow the *flexor* muſcles to ſend their tendons along this joint, ſecure from compreſſion in the hollow between the two oblong ſeſamoid bones; while, by removing theſe tendons from the center of motion, and giving them the advantage of an angle at their inſertion, the force of the muſcles is increaſed, and therefore the great ſuperincumbent weight of our body in progreſſion is more eaſily raiſed.

APPENDIX.

Of the Marks of a FEMALE SKELETON.

TO finiſh the deſcription of the bones, is generally to conclude the *oſteology*; but that no part of the ſubject may be left untouched, I think it neceſſary to ſubjoin the diſtinguiſhing marks of the male and female ſkeletons; and have choſen to illuſtrate them principally in the latter; becauſe women having a more delicate conſtitution, and affording lodging and nouriſhment to their tender *fœtuſes*, till they have ſufficient ſtrength and firmneſs to bear the injuries of the atmoſphere, and contact of other more ſolid ſubſtances, their bones are frequently incomplete, and always of a make in ſome parts of the body different from thoſe of the robuſt male; which agree to the deſcription already given, unleſs where the proper ſpecialities of the female were particularly remarked; which could not be done in all places where they occur, without perplexing the order of this treatiſe: Therefore I choſe rather to ſum them up here by way of *appendix*.

The cauſes of the following ſpecialities of the female bones may be reduced to theſe

three: 1. A weak lax conſtitution. 2. A ſedentary inactive life, increaſing that conſtitution. 3. A proper frame for being mothers.

The bones of women are ſmaller in proportion to their length than thoſe of men; becauſe the force of their muſcles is not ſo great, nor is ſuch ſtrong external force applied to them to prevent their ſtretching out in length.

The depreſſions, ridges, ſcabrous ſurfaces, and other inequalities made by the muſcles, are not ſo conſpicuous in them: becauſe their muſcles are neither ſo thick nor ſtrong, nor ſo much employed, to make ſo ſtrong prints on their bones.

Their *os frontis* is more frequently divided by a continuation of the *ſagittal* ſuture, which depends on the firſt and ſecond general cauſes aſſigned above, for the ſpecialities in their bones; as will appear after reflecting on the account given formerly of the middle internal ſpine of this bone.

Their *clavicles* are leſs crooked; becauſe their arms have been leſs forcibly pulled forwards, which in our *European* women, eſpecially thoſe of diſtinction, is more hindered by their garb.

Their *ſternum* is more raiſed by long cartilages below, that the *thorax* might be there widened in ſome proportion to what it is ſhortened by the preſſure upon the *diaphragm*, when they are with child.

The defect of bone, or the hole in the middle of the *ſternum*, is oftenеſt found in them,

them, to allow the paſſage of the mammary veſſels, ſay ſome; but, in my opinion, this is owing to a lax conſtitution, by which the oſſification is not ſo ſoon compleated as in men, where the action of the ſolids is vigorous, and the circulation of the fluids is briſk; for a much ſmaller hole might have ſerved this purpoſe; and the branches of the internal mammary veſſels which are ſent to the external parts of the *thorax*, do not paſs here, but between the cartilages of the ribs, before theſe are joined to the *ſternum*.

The *cartilago xiphoides*, is oftener bifurcated in women than men, for the reaſon aſſigned in the preceding paragraph, *viz.* a leſs forcible power of oſſification.

The ſuperior cartilages of the ribs ſooner oſſify, to ſupport the weight of the *mammæ*.

The middle cartilages are more flat and broad by the weight of the breaſts.

The inferior cartilages are longer, for enlarging the cheſt.

Weak women who have borne many children when young, often have the *vertebræ* of their back bended forwards, and their *ſternum* depreſſed, or become round ſhouldered and flat breaſted (*a*) by the preſſure and weight of the impregnated *uterus*, and by the ſtrong action of the abdominal muſcles.

The *os ſacrum* is broader and turned much more backwards, for enlarging the *pelvis*.

The *os coccygis* is more moveable, and much leſs bended forwards, to facilitate the birth.

(*a*) Cheſelden, Anatomy, book 1. chap. 3.

The *ossa ilium* are more hollow, and more reflected outwards, and consequently further removed from each other, in order to widen the lower part of their *abdomen*, and for the better support of the impregnated *uterus*.

The ridge on the upper part of the *os pubis* is larger in such women as have borne children, being extended by the strong action of the *musculi recti abdominis*.

The cartilage between the two *ossa pubis*, especially in women who have borne children, is thicker than in men, by which the *pelvis* is more capacious in females.

The conjoined surfaces of the *ossa pubis*, and of the *ossa innominata* and *sacrum* are less, the angle under the *symphysis* of the *ossa pubis*, is much larger, and the arches formed below and behind by the *ossa ilium* and *ischium* are wider, which, with the streighter *os sacrum*, and more distant *tubera ischii*, leave a larger passage for the exclusion of the child in birth.

The great tuberosity of the *ossa ischium*, is flatter in women than in men, because it is more pressed upon in the sedentary life which females enjoy.

In consequence of the *pelvis* of women being wider, the articulations of their thighbones must be farther removed from each other: and therefore a larger space is left for the procreation and birth of children (*a*); which distance of the thighs, may be one reason why women in running general shuffle more from

(*a*) Albin. de ossib. § 339.

from one ſide to the other than men, to preſerve the center of gravity of their bodies from falling too far to a ſide of the joint of the thigh that ſupports them when the other is raiſed, which would endanger their tumbling to the ground.

FINIS.

INDEX.

D

E

Jaw,

I

L

M

Radius,

R

S

U.

V.

W.

X.

Z.

THE

THE

ANATOMY

OF THE

HUMAN NERVES.

AND

A DESCRIPTION of the HUMAN LACTEAL SAC and DUCT.

The NINTH EDITION.

By ALEXANDER MONRO, *Senior*, *M. D.* and *P. A.*

PREFACE

To the Seventh EDITION.

BEING informed that the following Eſſays have been uſeful to the ſtudents in anatomy, I cave cauſed them to be reprinted with ſuch amendments as I thought neceſſary.

That offence might not be given, I have treated all the opinions concerning the diſputed phyſiology of the nerves with that deference which the uncertainty of the ſubject required; and have not only concealed the names of the writers whoſe ſentiments were different from mine, but have ſhunned quotations from thoſe whom I approve, leſt the knowledge of the latter ſhould be a key to diſcover the former by.

Deſcriptions of the very minute ramifications of the nerves are obſcure to the young gentlemen for whoſe uſe I write; and therefore I have taken notice only of the larger branches in the deſcription of the particular nerves.

The firſt occaſion of my publiſhing my great Maſter Boerhaave's doctrine concerning the Syſtole and Diaſtole of the heart, was to prevent the imputation I might have lain under of aſſuming

ming it to myſelf, when my worthy Maſter and good friend Mr. Cheſelden inſerted it into his anatomy, as communicated by me, without mentioning Boerhaave's name. Having now taken away all grounds of ſuch imputation, and the doctrine, though ſimple and beautiful, not appearing ſufficient to account for the phænomena of the motions of the heart, I have omitted it in this edition.

The deſcription of the receptaculum chyli and thoracic duct is more accurate, than in the common ſyſtems of anatomy; and on that account is here republiſhed.

The corrections and additions made in this edition of the anatomy of the bones, and of theſe Eſſays, ſhow, that I pretend not to Perfection; but I would however wiſh, that no more faults were imputed to me than what are really my own.

THE

THE

ANATOMY

OF THE

HUMAN NERVES.

Of the NERVES in general.

1. THE numerous turns which the *carotid* and *vertebral* arteries make before they paſs through the *dura mater*, theſe arteries having neither ſwelling muſcles nor preſſure of the atmoſphere to aſſiſt the courſe of the blood in them after they enter the ſcull, and their diviſion into innumerable communicating branches in the *pia mater*, and its proceſſes, ſhew, that the liquors muſt move more ſlowly and equally in them than in moſt other parts of the body.

2. By the aſſiſtance of injections and microſcopes, the very minute branches of theſe veſſels (§ 1.) are diſcovered to go from the *pia mater*, into the *cortex*, cineritious, or aſhy coloured part of the *cerebrum*, *cerebellum*,

bellum, and *ſpinal marrow*; whereas we can only ſee longitudinal veſſels, without numerous ramifications or reticular plexuſes, in the white medullary ſubſtance of theſe parts.

3. The continuity of the *cortex* with the *medulla* of the *encephalon* and *ſpinal marrow* is obſervable with the naked eye, and is more diſtinctly ſeen with the aſſiſtance of a microſcope.

4. In diſſecting the *brain* and *cerebellum*, we ſee the ſmall beginnings of the *medulla* proceeding from the *cortex*, and can trace its gradual increaſe by the addition of more ſuch white ſubſtance coming from the *cortex*.

5. Both theſe ſubſtances (§ 4) are very ſucculent; for being expoſed to the air to dry, they loſe more of their weight than moſt other parts of the body do.

6. In ſeveral places we can obſerve the *medulla* to be compoſed of fibres laid at each others ſides.

7. The medullary ſubſtance is employed in forming the white fibrous cords; which have now the name of *nerves* appropriated to them. Within the ſcull we ſee the nerves to be the medullary ſubſtance continued; and the *ſpinal marrow* is all employed in forming nerves.

8. The common opinion concerning the riſe of the nerves, founded on a ſuperficial inſpection of thoſe parts, is, that the nerves are propagated from that ſide of the *encephalon*, at which they go out of the ſcull. But it having been remarked, after a more ſtrict inquiry, and preparing the parts by maceration

in

in water, that the medullary fibres decuſſate or croſs each other in ſome parts of the *medulla*; as for example, at the *corpus annulare*, and beginning of the *ſpinal marrow:* And practical obſervators having related ſeveral examples of people whoſe brain was hurt on one ſide, while the morbid ſymptom, palſy, appeared on the other ſide of the body, of which I have ſeen ſome inſtances; and experiments made on brutes having confirmed theſe obſervations, it has been thought, that the nerves had their riſe from that ſide of the *encephalon*, which is oppoſite to their egreſs from the ſcull. It may however ſtill be ſaid, that this laſt opinion is not fully demonſtrated, becauſe a decuſſation in ſome parts is not a proof that it obtains univerſally; and if there are examples of palſy of the ſide oppoſite to where the leſion of the brain was, there are alſo others, where the injury done to the brain and the palſy were both on the ſame ſide.

9. The nerves are compoſed of a great many threads lying parallel to each other, or nearly ſo, at their exit from the *medulla*.

This fibrous texture is evident at the origin of moſt of the nerves within the ſcull; and in the *cauda equina* of the *ſpinal marrow*, we can divide them into ſuch ſmall threads, that a very good eye can ſcarce perceive them; but theſe threads, when looked at with a microſcope, appear each to be compoſed of a great number of ſmaller threads.

10. How ſmall one of theſe fibrils of the nerve is, we know not; but when we conſi-

der that every, even the moſt minute part of the body is ſenſible, and that this muſt depend on the nerves (which all conjoined, would not make a cord of an inch diameter) being divided into branches or filaments to be diſperſed through all theſe minute parts, we muſt be convinced that the nervous fibrils are very ſmall. From the examination of the *minimum viſibile*, it is demonſtrated, that each fibre in the *retina* of the eye or expanded optic nerve, cannot exceed the ſize of the 32,400 part of a hair.

11. The medullary ſubſtance, of which the nervous fibrils are compoſed, is very tender, and would not be able to reſiſt ſuch forces as the nerves are expoſed to within the bones, nor even the common force of the circulating fluids, were not the *pia mater* and *tunica arachnoides* continued upon them; the former giving them firmneſs and ſtrength, and the latter furniſhing a cellular coat to connect the threads of the nerves, to let them lie ſoft and moiſt, and to ſupport the veſſels which go with them.

It is this cellular ſubſtance that is diſtended when air is forced through a blow pipe thruſt into a nerve, and that makes a nerve appear all ſpongy, after being diſtended with air till it dries; the proper nervous fibrils ſhrivelling ſo in drying, that they ſcarce can be obſerved.

13. Theſe coats (§ 11.) would not make the nerves ſtrong enough to bear the ſtretching and preſſure they are expoſed to in their courſe to the different parts of the body; and there-

fore

fore, when the nerves go out at the holes in the *cranium* and *ſpine*, the *dura mater* is generally wrapt cloſely round them, to collect their diſgregated fibres into tight firm cords; and that the tenſion which they may happen to be expoſed to, may not injure them before they have got this additional coat, it is firmly fixed to the ſides of the holes in the bones through which they paſs.

13. The nervous cords thus compoſed of nervous fibrils, cellular coat, *pia* and *dura mater*, have ſuch numerous blood-veſſels, that after their arteries only are injected, the whole cord is tinged of the colour of the injected liquor: and if the injection is puſhed violently, the cellular ſubſtance of the nerves is at laſt diſtended with it.

14. A nervous cord, ſuch as has been juſt now deſcribed, (§ 13), has very little elaſticity, compared with ſeveral other parts of the body. When cut out of the body, it does not become obſervably ſhorter, while the blood veſſels contract three eighths of their length.

15. Nerves are generally lodged in a cellular or fatty ſubſtance, and have their courſe in interſtices of muſcles, and other active organs, where they are guarded from preſſure; but in ſeveral parts they are ſo placed, as if it was intended that they ſhould there ſuffer the vibrating force of arteries, or the preſſure of the contracting fibres of muſcles.

16. The larger cords of the nerves divide into branches as they go off to the different parts; the branches being ſmaller than the

trunk from which they come, and making generally an acute angle where they ſeparate.

17. In ſeveral places, different nerves unite into one cord, which is commonly larger than any of the nerves which form it.

18. Several nerves, particularly thoſe which are diſtributed to the bowels, after ſuch union, (§ 17), ſuddenly form a hard knot conſiderably larger than all the nerves of which it is made. Theſe knots were called *corpora olivaria*, and are now generally named *ganglions*.

19. The *ganglions* have thicker coats, more numerous and larger blood-veſſels than the nerves; ſo that they appear more red and muſcular. On diſſection the *ganglions*, fibres are ſeen running longitudinally in their axes, and other fibres are derived from their ſides in an oblique direction to the longitudinal ones.

20. Commonly numerous ſmall nerves, which conjunctly are not equal to the ſize of the *ganglion*, are ſent out from it, but with a ſtructure no way different from that of other nerves.

21. The nerves ſent to the organs of the ſenſes, loſe there their firm coats, and terminate in a pulpy ſubſtance. The *optic nerves* are expanded into the ſoft tender webs, the *retinæ*. The *auditory nerve* has ſcarce the conſiſtence of *mucus* in the *veſtibulum*, *cochlea*, and *ſemicircular canals* of each ear. The *papillæ* of the noſe, tongue and ſkin, are very ſoft.

22. The nerves of muſcles can likewiſe be traced till they ſeem to loſe their coats by becoming very ſoft; from which, and what we obſerved of the ſenſatory nerves (§ 21.), there is reaſon

reaſon to conclude, that the muſcular nerves are alſo pulpy at their terminations, which we cannot indeed proſecute by diſſection.

23. It would ſeem neceſſary that the extremities of the nerves ſhould continue in this ſoft flexible ſtate, (§ 21. 22.), in order to perform their functions right: For, in proportion as parts beome rigid and firm by age, or any other cauſe, they loſe of their ſenſibility, and the motions are more difficultly performed.

24. Though the fibres in a nervous cord are firmly connected, and frequently different nerves join into one trunk, or into the ſame *ganglion*; yet the ſenſation of each part of the body is ſo very diſtinct, and we have ſo much the power of moving the muſcles ſeparately, that, if the nerves are principal agents in theſe two functions, which I ſhall endeavour to prove they are, we have reaſon to believe that there is no union, confuſion, or immediate communication of the proper nervous fibrils, but that each fibre remains diſtinct from its origin to its termination.

25. Changes produced any way upon the coats of the nerves, cannot however miſs to affect the nervous fibrils. The cellular ſubſtance may be too full of liquor, or may not ſupply enough; the liquor may not be of a due conſiſtence, or it may be preternaturally obſtructed and collected. The *pia* or *dura mater* may be too tenſe, or too lax; their veſſels may be obſtructed; their proper nerves may be violently irritated, or loſe their power of acting; and a great many other ſuch changes may happen, which will not only occaſion diſ-

orders in particular nerves, but may be a cauſe of the *ſympathy* ſo frequently obſerved among the nerves; which is ſo neceſſary to be attentively regarded in a great many diſeaſes, in order to diſcover their true ſtate and nature, that, without this knowledge, very dangerous miſtakes in the practice of phyſic and ſurgery may be committed.

26. Many experiments and obſervations concur in proving, that when nerves are compreſſed, cut, or any other way deſtroyed, the parts ſerved by ſuch nerves, farther from the head or ſpine than where the injuring cauſe has been applied, have their ſenſations, motions, and nouriſhment weakened or loſt, while no ſuch effects are ſeen in the parts nearer to the origin of thoſe nerves; and in ſuch experiments where the cauſe impeding the nerves to exert themſelves could be removed, and the ſtructure of the nerves not injured; as for example, when a ligature made upon a nerve and ſtopping its influence has been taken away, the motion and ſenſation of the parts ſoon were reſtored. From which it would appear, that the nerves are principal inſtruments in our ſenſations, motions, and nouriſhment; and that this influence of the nerves is not inherent in them, without the communication between theſe cords and their origin is preſerved.

This concluſion is juſt, notwithſtanding that ſometimes, upon cutting a nerve, the effects above-mentioned have been felt for a ſhort time; but afterwards the perſon was ſenſible of

of no numbneſs or immobility; for where-ever this is ſaid to have happened, the cut nerve was only one of ſeveral which were ſent to the member; the want of whoſe influence was felt no longer, than till the habit was acquired of performing the functions eaſily by the other nerves.

Nor is it of greater weight as an objection, that ſometimes when a ligature is drawn very hard upon a nerve, and then is taken away, the nerve never again recovers its influence upon the parts it is diſtributed to beyond the ligature, but is of as little effect as if it had been cut through; which is to ſay, that its texture has been altered beyond recovery. The ſame thing is to be ſeen by tying a thread tight round a tender twig of any vegetable; it decays.

27. Experiments and obſervations ſhew too, that when parts of the *encephalon* or *ſpinal marrow* have been irritated, compreſſed, or deſtroyed, the parts of the body, whoſe nerves had their origin from ſuch affected parts of the *encephalon* or *ſpinal marrow*, became convulſed, paralytic, inſenſible, or waſted; and in ſuch caſes where the injuring cauſe could be removed from the origin of the nerves, the morbid ſymptoms obſerved in the parts to with theſe nerves were diſtributed, went off upon the removal of that cauſe. From which it is thought reaſonable to conclude, that the nerves muſt not only have a communication with their origin, but that the influence they have upon the parts they are diſtributed to de-

pends on the influence which they derive from the *medulla encephali* and *ſpinalis*.

28. Though the *ſpinal marrow* has its own veſſels and cineritious ſubſtance which aſſiſts to form its *medulla*; yet a very large ſhare of the medullary ſubſtance within the ſpine is derived from the *encephalon*, whoſe *medulla oblongata* deſcends from the head, and the influence of the *ſpinal marrow* on its nerves depends in a great meaſure on this *medulla oblongata* of the head. Hence an injury done to any part of the *ſpinal marrow*, immediately affects all the parts whoſe nerves have their origin below where the injuring cauſe is applied. A luxation of a *vertebra* in the loins makes the lower extremities ſoon paralytic; a tranſverſe ſection of the *medulla* at the firſt *vertebra* of the neck, ſoon puts an end to life.

29. If ſuch cauſes produce conſtantly ſuch effects (§ 26. 27. 28.) in us and other creatures living in nearly the ſame circumſtances as we do, the concluſions already made muſt be good, notwithſtanding examples of children and other creatures being born without *brains* or *ſpinal marrow*; or notwithſtanding that the brains of adult creatures can be much changed in their texture by diſeaſes: and that *tortoiſes*, and ſome other animals continue to move a conſiderable time after their heads are cut off. We may be ignorant of the particular circumſtances requiſite or neceſſary to the being or well-being of this or that particular creature, and we may be unable to account for a great many *phænomena*; but we muſt believe our eyes in the examination of facts;

facts; and if we see constantly such consequences from such actions, we cannot but conclude the one to be the cause and the other the effect. It would be as unjust to deny the conclusions made in the three preceding articles, because of the seemingly preternatural phænomena mentioned at the beginning of this, as it would be to deny the necessity of this circulation of the blood in us and most quadrupeds, because a frog can jump about, or a tortoise can walk long after the bowels of its thorax and abdomen are taken out, or because the different parts of a worm crawl after it has been cut into a great many pieces. It is therefore almost universally allowed that the nerves are *principal* instruments in our sensations, motion, and nourishment; and that the influence which they have is communicated from their origin, the *encephalon* and *medulla spinalis*. But authors are far from agreeing about the manner in which this influence is communicated, or in what way nerves act to produce these effects.

30. Some alledge, that *the nervous fibres are all solid cords acting by elasticity or vibration*; others maintain, that *those fibres are small pipes conveying liquors, by means of which their effects are produced.*

31. The gentlemen, who think the nervous fibres solid, raise several objections to the other doctrine; which I shall consider afterwards; and endeavour to shew the fitness of their own doctrine to account for the effects commonly observed to be produced by the nerves.

The objects of the ſenſes plainly (ſay they) make impulſes on the nerves of the proper organs, which muſt ſhake the nervous fibrils: and this vibration muſt be propagated along the whole cord to its other extremity or origin, as happens in other tenſe ſtrings; and theſe vibrations being differently modified, according to the difference of the object, and its different application, produce the different ideas we have of objects.

32. To this account of ſenſation, it is objected, *firſt*, That nerves are unfit for vibrations, becauſe their extremities, where objects are applied to them, are quite ſoft and pappy (§ 21.), and therefore not ſuſceptible of the vibrations ſuppoſed; and if there could be any little tremor made here by the impulſe of objects, it could not be continued along the nervous cord, becauſe the cellular ſubſtance by which each particular fibre is connected to the neighbouring ones (§ 11.) and the fatty ſubſtance in which the nervous cord is immerſed (§ 15.), would ſoon ſtifle any ſuch vibratory motion.

A *ſecond* objection to this doctrine is, that ſuppoſing the nerves capable of vibrations by the impreſſions of objects, theſe vibrations would not anſwer the deſign. For if what we know of other vibrating ſtrings, to wit, that their tone remains the ſame, unleſs their texture, length, or tenſion is altered, and that different ſubſtances ſtriking them do no more than make the ſound higher or lower; if theſe properties are to be applied to nerves, then it will follow, that the ſame nerve would conſtantly convey the ſame idea, with no other variety than

than of its being weaker and ſtronger, whatever different objects were applied to it; unleſs we ſuppoſed the nerve changed in its texture, length, or tenſion, each time a different object is applied; which, it is preſumed, no body will undertake to prove does happen.

Nay, 3*dly*, If ever ſuch a variety of vibrations could be made, our ſenſations would notwithſtanding be confuſed and indiſtinct, becauſe the tremulous nervous fibre being firmly connected and contiguous to ſeveral other fibres of the ſame cord, would neceſſarily ſhake them too, by which we ſhould have the notion of the object as applied at all the different parts where the extremities of theſe fibres terminate.

33. In whatever way the favourers of the doctrine of ſolid nerves pleaſe to apply the elaſticity of nerves to the contraction of muſcles, their adverſaries inſiſt that nerves are too weak to reſiſt ſuch weights as the muſcles ſuſtain; they would ſurely break, eſpecially as they are in a great meaſure, if not wholly, deprived of their ſtrong coats before they come to the part of the muſcle they are immediately to act upon (§ 22.)—The nerves being found to have little or no elaſticity to ſhorten themſelves (§ 14.), ſhew them altogether unfit for ſuch an office as this of contracting muſcles in the way propoſed of their acting by elaſticity; and when a nerve is viewed with a miſcroſcope while the muſcles it ſerves are in action, no contraction or motion is obſerved in it.——— Nay, if they were elaſtic, they would equally exert their power of contracting muſcles nearer to their origin as well as farther from it, when

when they were put into contraction or vibration, by irritation of any part of them. The former however does not happen.

34. As a further objection againſt either motion or ſenſation being owing to the elaſticity of the nerves, it is ſaid, that if this doctrine was true, the ſenſations would be more acute, and the contractions of muſcles would be greater and ſtronger, when the parts become firmer and more rigid by age; for then their elaſticity is increaſed: Whereas, on the contrary, it appears (§ 23.), that then the ſenſations are blunted, and muſcular contraction becomes leſs and weaker.

35. If the nerves were granted to be elaſtic, and to communicate a ſpringy force to all the parts they are diſtributed to, they might appear neceſſary in this view to aſſiſt the application of the nutritious particles of the fluids to the ſides of the veſſels which theſe particles were to repair; and ſo far might well enough account for the ſhare which nerves are thought to have in nutrition: But if we cannot make uſe of elaſticity in the other two functions, ſenſation and motion, we muſt alſo endeavour to find out ſome other way for the nerves to act in nutrition; which will be done afterwards.

36. Having thus ſtated the reaſons for and againſt the nerves acting as ſolid ſtrings, let us likewiſe relate the arguments for nerves being pipes, and the objections to this doctrine.

A great argument of thoſe who think the nerves to be tubes conveying liquors, is the ſtrong

ſtrong analogy of the brain and nerves to other glands of the body and their excretories, where a manifeſt ſecretion of liquor is made in the glands, to be conveyed by the excretories to the proper places in which it ought to be depoſited: They think that the vaſcular texture of the *cortex* of the *encephalon* and *ſpinal marrow* (§ 2.), the continuation of the *cortex* in forming the medullary ſubſtance (§ 3. 4.), the fibrous texture (§ 6.), and ſucculent ſtate of this *medulla* (§ 5.), and its being wholly employed to form the nerves (§ 7.), where the fibrous texture is evident (§ 9.); all theſe things, ſay they, conſpire to ſhew ſuch a ſtrong analogy between theſe parts and the other glands of the body, as carries a conviction that there is a liquor ſecreted in the *encephalon* and *ſpinal marrow*, to be ſent out by the nerves to the different parts of the body.

37. The following objections are raiſed to this argument in favour of liquor conveyed in the nerves from the analogy of the glands. 1*ſt*, Other glands, it is ſaid, have their excretories collected into a few large pipes, and not continued in ſuch a great number of ſeparate pipes, as far as the places where the liquors are depoſited; which laſt muſt be the caſe, if the nerves are the excretories of the glandular brain. 2*dly*, We ſee the cavities, and can examine the liquors in the excretories of other glands much ſmaller than the brain; which cannot be done in the nerves. 3*dly*, If the nerves were pipes, they would be ſo ſmall, that the attraction of the liquors to their ſides, would prevent that celerity in the motion

tion of the liquor, which is requiſite to ſenſations and motions. 4*thly*, If the nerves were pipes, they would be cylindrical ones, and conſequently not ſubject to diſeaſes; or at leaſt we could have no comprehenſion of the diſeaſes in them.

38. The anſwer to the 1*ſt* of theſe objections is, That there are other glands where there is a manifeſt ſecretion, and in which the diſpoſition of the excretories is in much the ſame way as in the *encephalon:* The kidneys, for example, have a reticulated *cortex* of veſſels, from which the *Euſtachian* or *Bellinian medulla*, conſiſting of longitudinal fibres and a few blood veſſels in the ſame direction, proceeds; and this *medulla* is collected into ten, twelve, or more *papillæ*, each of which is formed of numerous ſmall ſeparate pipes, which ſingly diſcharge the urine into the large membranous tubes; and theſe united form the *pelvis*. Upon comparing this texture of the kidneys with that of the *encephalon* (§ 2. 3. 4. 5. 6. 7. 9.) the analogy will be found very ſtrong.

39. In anſwer to the 2*d* objection, in § 37. it is granted, that microſcopes, injections, and all the other arts hitherto employed, have not ſhewn the cavities of the nervous fibrils, or the liquors contained in them; and from what was ſaid (§ 10.) of the ſmallneſs of the nervous fibrils, it is not to be expected that ever they ſhould be ſeen. But ſo long as ſuch a number of little animals can every hour be brought to the objectors, in which they can as little demonſtrate the veſſels or contained fluids, it will not be allowed to be concluſive reaſoning,

reaſoning, that becauſe ocular demonſtration cannot be given of either the tubes or their contents, therefore they do not exiſt. For if we have any notion of an animal, it is its being an hydraulic machine, which has liquors moving in it as long as it has life; if therefore ſuch little animals have veſſels and liquors which we cannot ſee, why may not ſome of the veſſels and liquors of the human body be alſo inviſible to us?

To avoid this anſwer to the objection, it is further urged, That though we might not ſee the nervous tubes or the liquors they contain, as they naturally flow; yet if ſuch liquors really exiſt, they ought to diſcover themſelves, either by a nerve's ſwelling when it is firmly tied; or that, however ſubtile their fluids are, they might be collected in ſome drops, at leaſt, when the cut end of a nerve of a living animal is kept ſome time in the exhauſted receiver of an air-pump. It is affirmed, that neither did the tied nerve ſwell between the brain and ligature, nor was there any liquor collected in the receiver of the air-pump; from which it is concluded, that there is no liquor in the nerves.

Some, who ſay they have tried theſe experiments, affirm, that in young animals the nerve does ſwell above the ligature, and that a liquor does drill out upon cutting a nerve. ——Whether ſwelling or liquor is ſeen or is not ſeen in theſe experiments, no concluſion for or againſt a nervous fluid can be made from them; for the ſwelling of the

nerve

nerve after it is tied, or the efflux of liquors from its extremity, will never prove either to be the effect of the fluid in the proper nervous fibrils, ſo long as they might be occaſioned by the liquors in the larger veſſels of the cellular ſubſtance of the nerves; and if theſe ſame veſſels of the coats of the nerves do not diſcover their liquors by theſe experiments, it is far leſs to be expected, that the much more ſubtile nerves will diſcover theirs.

40. The 3*d* Objection to the doctrine of the brain being a gland, and the nerves its excretories, ſuppoſes a more rapid motion neceſſary in the fluid of the nerves, than what moſt of the defenders of the nervous fluid will now allow; and is afterwards to be conſidered particularly in a more proper place.

41. The 4*th* Objection being, That if nerves are excretories of a gland, they muſt be cylindrical pipes, in which no obſtructions or diſeaſes would happen; but ſince we daily ſee diſeaſes in the nerves, they muſt therefore not be ſuch excretories. The anſwer is, That diſeaſes happen often in the excretories of other glands, as of the liver, kidney, *&c.* notwithſtanding their cylindrical form, and their much ſhorter and leſs expoſed courſe. When we conſider the very tender ſubſtance of the brain, the vaſt complication of veſſels there, the prodigious ſmallneſs of the pipes going out from it, the many moving powers which the nerves are to undergo the ſhock of, and the many chances which the veſſels, membranes, and cellular ſubſtance accompanying the nerves have of being diſ-

ordered,

ordered, and then affecting the nervous fibrils, we have very great reaſon to be ſurpriſed, that theſe cylindrical pipes are not much more frequently put out of order, by too great or too ſmall a quantity of liquors; by too viſcid or too thin fluids; by liquors conſiſting of too mild and ſluggiſh particles, or of too acrid pungent ones; by too great or too little motion given to the liquors; by the diameters of the pipes being too much ſtraitened, or too much inlarged; and by a great many other varieties of circumſtances which might be thought capable of diſturbing the functions of the nerves, ſuppoſing them to be cylindrical excretories of the gland, the brain.

42. The numerous veſſels of the *encephalon* have brought ſome of the gentlemen who aſſert the nerves to be ſolid, to acknowledge, that there is a liquor ſecreted in the brain: But then they will not allow that this liquor is ſent out by the proper nervous fibrils; but that it is poured into the cellular ſubſtance in which the nerves lie, to keep them moiſt and ſupple, and therefore fit for exerting their elaſticity, vibration, *&c.* by which, in their opinion, the effects commonly aſcribed to nerves are produced.

43. Beſides the objections already mentioned (§ 32. 33.) againſt the nerves acting as elaſtic ſtrings, this opinion has ſome other difficulties which may be objected to it: For inſtance, there is not one analogous example in the whole body of liquors ſecreted in a large gland,

gland, to be poured into a cellular ſubſtance, as is here ſuppoſed; the liquors in the cells of the *tela cellularis* of other parts are ſeparated from the little arteries which are diſtributed to theſe cells.

Further, it cannot be imagined, how a liquor ſecreted in the *cortex* of the brain ſhould make its way through the *medulla*, to come out into the cellular membranes on the ſurface of that *medulla*.

Laſtly, A very ſimple experiment, of injecting water by the artery of any member, and thereby filling the cellular ſubſtance of the nerves of that member, ſhews evidently, that the liquor of the *cellular* ſubſtance of the nerves has the ſame fountain as the liquor has in the *tela cellularis* any where elſe, that is, from the little arteries diſperſed upon it.

44. The doctrine of a fluid in the nerves, is not only thus ſupported by the analogy of the brain and nerves to the other glands and their excretories, but thoſe who maintain this doctrine mention an experiment which they think directly proves a fluid in the nerves. It is this: After opening the thorax of a living dog, catch hold of and preſs one or both the *phrenic* nerves with the fingers, the *diaphragm* immediately ceaſes to contract; ceaſe to compreſs the nerves, and the muſcle acts again: A ſecond time, lay hold of the nerve or nerves ſome way above the *diaphragm*, its motion ſtops. Keep firm the hold of the nerve, and, with the fingers of the other hand

hand ſtrip it down from the fingers which make the compreſſion towards the *diaphragm*, and it again contracts: A repetition of this part of the experiment three or four times, is always attended with the ſame effects; but it then contracts no more, ſtrip as you will, unleſs you remove the preſſure, to take hold of the nerves above the place firſt pinched: when the muſcle may again be made to contract, by ſtripping the nerve down towards it. This experiment I have done with the ſucceſs here mentioned. Let any one try if he can imagine any other reaſonable account of theſe appearances, than that the preſſure by the fingers ſtopped the courſe of a fluid in the nerve; that ſo much of this fluid as remained in the nerve, betwixt the fingers and *diaphragm* was forced into that muſcle by ſtripping, and when it was all preſſed away, the fingers above prevented a ſupply, the muſcle contracted no more till the fingers were removed, and a freſh flow by that means was received from the ſpinal marrow, or from that part of the nerve which had yet not been ſo ſtripped.

It has been objected to the concluſions from this experiment, 1. That the *diaphragm* is ſet in motion by ſtripping the nerve from, as well as towards, this muſcle; and this may be well expected; for a liquor in ſuch ſmall pipes hindered to flow backwards by ligature, pinching fingers, or even the flow of their liquors from the fountain, will regurgitate forwards with velocity, when preſſed backwards. We

ſee

ſee it happen in the ſtalks of tender ſucculent plants.

2. It is ſaid, that muſcles ceaſe to act when their veins are tied, as well as when their arteries or nerves are tied or cut, but that muſcles continue to act when their veins are cut; by which it would appear, that the overloading of the veſſels is an impediment to the action of muſcles, and therefore the ceaſing of their action when their arteries or nerves are tied or cut, may alſo be owing to the liquor in the branches of theſe pipes of muſcles ſtagnating when it is not propelled by the flow of more liquor from their trunks, and not to any influence or moving power, which now ceaſes to be conveyed to them.

It is to be obſerved in making the experiments juſt now mentioned, that the contraction of the muſcles ceaſes ſooneſt when the nerves, and lateſt when the veins are tied.——That when veins are tied, not only are the veſſels overloaded, but all the cellular ſubſtance of the muſcles is filled with coagulated blood; whereas when the arteries and nerves are tied, the reverſe is ſeen, the muſcles are lax and of leſs bulk. So that in theſe caſes the ceaſing of the contraction of the muſcles ſeems to depend on very different cauſes, to wit, a deprivation of neceſſary liquors in the one, and a redundancy of ſuperfluous blood in the other. An elaſtic ſtick may be deprived of its elaſticity by being made either too dry or too wet.

45. Some gentlemen, convinced of the reaſonableneſs of the ſecretion of a liquor in the brain to be ſent out by the nerves, but not comprehending

comprehending how a fluid could have ſuch a rapid retrograde motion as they imagined was neceſſary for conveying the impreſſions of objects made on the extremities of nerves to the *ſenſorium*, ſuppoſed two ſorts of nerves; one that conveyed a liquor for muſcular motion and nutrition; the other compoſed of ſolid nerves, that were to ſerve for organs of the ſenſes, to convey the vibrations communicated from objects to the *ſenſorium*.

46. To this opinion (§ 45.) the objections againſt the ſenſatory nerves acting by vibration (§ 32.) may be made; and there is ſo little reaſon to ſuſpect any difference in the texture of the different parts of the brain or nerves, that, on the contrary, the ſtructure is every where ſimilar, and branches of the ſame nerve often ſerve both for ſenſation and motion.

How little neceſſity there is for ſuppoſing extremely rapid motions of the nervous fluid, is to be examined ſoon.

47. The hypotheſis of great celerity in the motion of the fluid of the nerves being neceſſary, gave alſo riſe to another diviſion of the nerves, into *arterious* or *effluent*, and *venous* or *refluent*. It was ſaid, that muſcular motion and nutrition depended on the arterious nerves; and that the ſenſations depended on an accelerated motion of the nervous fluid towards the brain, by the impreſſions which the objects of the ſenſes make upon the venous nerves. By this ſuppoſition the abſurdity of rapid fluxes and refluxes in the ſame canal

was

was prevented, and an advantage was thought to be gained by it, of ſaving too great a waſte of the fluid of the nerves, which otherwiſe the *encephalon* and *ſpinal marrow* could not ſupply in ſufficient quantity to anſwer all the exigencies of life.

48. To this opinion (§ 47.) it has been objected, 1*ſt*, That there is no example in the body of a ſecreted liquor being returned immediately and unmixed to the gland by which it was originally ſeparated from the maſs of blood; which would be the caſe were there venous nerves. 2*dly*, There is no occaſion for ſaving the fluid of the nerves in the way propoſed; the organs for ſecreting that fluid being large enough to ſupply all that is neceſſary of it in the common functions of life.—3*dly*, If the fluid of the nerves was to be thus kept in a perpetual circulation, it would ſoon become too acrid for continuing with ſafety in ſuch ſenſible tender veſſels as the brain and nerves are compoſed of. 4*thly*, This hypotheſis will not anſwer the deſign for which it was propoſed: For though the momentary application of an object might cauſe an acceleration in the fluid of venous nerves, yet if the object was kept applied to the nerves, it would ſtop their fluid, ſo that it could not go forward to the brain; and therefore, according to this doctrine, we ſhould be ſenſible of no objects except thoſe whoſe application to the organs of the ſenſes was momentary.

49. Let us now ſuppoſe it probable, that the *encephalon* and *ſpinal marrow* ſecern a liquor from

from the blood which is ſent into all the nerves, and that by the means of this liquor, the nerves perform the offices commonly aſſigned to them; it is next neceſſary to inquire what kind of liquor this is, and how it moves, in order to determine how well its nature and motion are fitted for performing what is expected from it.

50. The liquor of the nerves has been fancied by ſome to be of a very ſtrong acid or alcaline nature: But ſince none of our juices appear to be of this ſort, and ſince ſuch liquors irritate and deſtroy the parts of the body which they are applied to, we cannot conceive how the brain can ſeparate, or the nerves could bear any thing of ſuch an acrid nature. This tenderneſs and ſenſibility of theſe organs muſt hinder us abſolutely from ſuppoſing that the liquor of the nerves can be acrid or pungent, or of the nature of ſpirit of wine, hartſhorn, &c.

51. Some have imagined the liquor of the nerves to be capable of vaſt exploſion like gun-powder, or of violent ſudden rarefaction like air, or of ſtrong ebullition like boiling water, or the mixture of acids with alcaline liquors. But as the maſs of blood from which this fluid is derived, is not poſſeſſed of any ſuch properties, we cannot ſuppoſe the blood to furniſh what it has not in itſelf. Beſides, all theſe operations are too violent for the brain or nerves to bear; and when once they are begun, they are not ſo quickly controlled or reſtrained, as experience teaches us the nerves can be made to ceaſe from acting.

52. We

52. We are not ſufficiently acquainted with the properties of an *æther* or *electrical effluvia* pervading every thing, to apply them juſtly in the animal œconomy; and it is as difficult to conceive how they ſhould be retained or conducted in a long nervous cord. Theſe are difficulties not to be ſurmounted.

53. The ſureſt way of judging what kind of liquor this of the nerves muſt be, is to examine the liquors of ſimilar parts of the body. All the glands ſeparate liquors from the blood much thinner than the compound maſs itſelf; ſuch is the *liquor* poured into the cavity of the *abdomen*, *thorax*, *ventricles of the brain*, the *ſaliva*, *pancreatic juice*, *lymph*, &c. Wherever there is occaſion for ſecreted liquors being thick and viſcid, in order to anſwer better the uſes they are intended for, nature has provided reſervoirs for them to ſtagnate in, where their thinner parts may be carried off by the numerous abſorbent veins diſperſed on the ſides of thoſe cavities; or they may exhale where they are expoſed to the open air. The *mucus of the noſe* becomes viſcid by ſtagnation; for, when it is immediately ſecreted, it is thin and watery; as appears from the application of ſternutatories, &c. The *cerumen* of the ears is of a watery conſiſtence, when juſt ſqueezing out. The *mucus* of the alimentary canal grows thick in the *lacunæ*. The bile in the hepatic duct has little more conſiſtence than lymph; that in the gall-bladder is viſcid and ſtrong. The *urine* is much more watery as it flows from the kidneys, then when it is excreted

creted from the bladder. The *ſeed* is thin as it comes from the teſticles, and is concocted in the *veſiculæ ſeminales*, &c.

54. Hence (§ 53) we may ſafely conclude, that a thin liquor is ſecreted in the *cortex encephali* and *ſpinal marrow*; and ſeeing the thinneſs of ſecreted liquors is generally, as the diviſion of the veſſels, into ſmall ſubtile branches, and that the ramifications within the ſcull are almoſt infinitely ſubtile, the liquor ſecreted in the *encephalon* may be determined to be among the fineſt or thinneſt fluids.

55. Seeing alſo that we can obſerve no large reſervoir, where the liquor ſecerned in the *cortical ſubſtance* is depoſited, to have its finer parts taken off, we have reaſon to think, that it goes forward into the nerves in the ſame condition in which it is ſecerned.

56. By fine or ſubtile animal liquors, is meant no more than thoſe which are very fluid, and which ſeem to conſiſt of a large proportion of watery particles, and a leſſer one of the oily, ſaline, and terreſtrious particles. Some of the liquors which we can have in ſufficient quantity to make experiments with, are ſo fluid, and have ſo little viſcidity or coheſion of parts, that when laid upon a piece of clean mirror, they evaporate without leaving a ſtain; ſuch is the liquor ouſing out from the ſurface of the *pleura*, the lymph, and ſeveral others.

If then theſe liquors, which are ſubject to our examination, the ſecerning veſſels of which are ſo large that we can ſee them, have ſuch a ſmall coheſion of parts, it might not

be unreaſonable to ſay, that the liquor of the nerves is as much more fine and fluid than lymph as the veſſels ſeparating it are ſmaller; and therefore that the fluid of the nerves is a defecated water, with a very ſmall proportion of the other principles extremely ſubtilized.

57. Two experiments are ſaid to contradict this opinion of the liquor of the nerves being ſo fluid and ſubtile. One is, that upon cutting the *cauda equina* of a living animal, a liquor as viſcid as the white of an egg drops out: The other is, that a wounded nerve yields a *glairy ſanies*. But theſe don't appear to be the proper fluid of the nerves; ſince it is evident, that what is diſcharged in both theſe caſes, comes out of the cellular ſubſtance involving the nervous fibrils.

58. Conſidering how many experiments make it evident, that there is a conſtant uninterrupted ſtream of liquors flowing through all the canals of animals, which convey liquors compoſed of particles ſmaller than the diameter of their canal, which is always the caſe of the nerves in a natural ſtate; it is ſurprizing how it ever could be thought that the liquid of the nerves ſhould be obliged to flow from the brain to each muſcle the moment we will; or that this liquor ſhould flow back with the like ſwiftneſs from the extremity of each nerve, to which an object of ſenſation is applied. The nerves, as well as the other excretories of the glands, always are full of liquor; the degree of diſtenſion of the canals not being at all times alike even in a found

ſound ſtate. But this happens without inconvenience, as the ſides of the canals have a power to accommodate themſelves to the preſent quantity, unleſs it is very much above or below the natural ſtandard; in both which caſes diſeaſes enſue.

59. The motion of the fluid in the nerves is therefore not only conſtant, but it is alſo equal, or nearly ſo: For, though the blood in the larger arteries is moved unequally by the unequal forces, the contraction of the ventricle of the heart, and the weaker power, the *ſyſtole* of the arteries; yet the difference between theſe two moving powers comes to be leſs and leſs perceptible, as the arteries divide into ſmaller branches; becauſe of the numerous reſiſtances which the liquors meet with, and becauſe the canals they move in become larger, till in the very ſmall arterious branches, there is no ſenſible difference in the velocity of the liquors from the effect of the heart or arteries. The motion of the fluids muſt ſtill be more equal in the excretories of glands, and particularly in thoſe where the veſſels have divided into very minute branches, and the liquors have no other propelling force but the heart and arteries, (ſee § 1.) therefore the nervous fluid moves conſtantly, equally, and ſlowly, unleſs when its courſe is altered by the influence of the mind, or by the preſſure of ſome neighbouring active organ.

60. As there is neither proof nor probability of the *valves* ſuppoſed by ſome in nerves, we are not to aſſume them in accounting for any *phænomena*.

61. We have not, and perhaps cannot have any idea of the manner in which mind and body act upon each other; but if we allow that the one is affected by the other, which none deny, and that the fluid of the nerves (whatever name people please to give it) is a principal inſtrument which the mind makes uſe of to influence the actions of the body, or to inform itſelf of the impreſſions made on the body, we muſt allow that the mind can direct this inſtrument differently, particularly as to quantity and celerity, though we muſt remain ignorant of the manner how many *phænomena* depending on this connection of mind and body are produced. Thus we ſhould in vain attempt to account for animals continuing, after their heads were ſtruck off, or their hearts were cut out, to perform actions begun before they ſuffered any injury.

62. Let us now ſuppoſe the nervous fluid ſuch as has been argued for, to wit, a very fluid ſaponaceous water, moving in a conſtant, equal, ſlow ſtream, from the *encephalon* and *ſpinal marrow*, in each of the proper nervous fibres, except when the motion is changed by ſome acceſſory cauſe, ſuch as the mind, preſſure of other parts, &c. and let us examine how well ſuch a ſuppoſition will agree with the *phænomena* of the three great functions, nutrition, ſenſation, and muſcular motion, which the nerves are principal inſtruments of.

63. In general, we may ſay, that nerves can carry fluids to the moſt minute part of the body, to ſupply what is waſted in any of the ſolids; that the impreſſion made by the objects

jects of the ſenſes on the very ſoft pulpy extremities of the nerves of the organs of the ſenſes, muſt make ſuch a ſtop in the equal-flowing nervous fluid, as much inſtantaneouſly be perceptible at the fountain head from which the pipes affected ariſe; that the conſtant flow of the liquor of the nerves into the cavities of the *muſcular fibrillæ*, occaſions the natural contraction of the muſcles, by the as conſtant *niſus* it makes to increaſe the tranſverſe and to ſhorten the longitudinal diameter of each fibre; and that it is only to allow the mind a power of determining a greater quantity of this ſame fluid with a greater velocity into what muſcular fibres it pleaſes, to account for the voluntary ſtrong action of the muſcles.

64. But ſince ſuch a ſuperficial account would not be ſatisfactory, it will be expected, that the principal *phænomena* of theſe three functions ſhould be explained by the means of ſuch a fluid as has been ſuppoſed, and that the ſeveral objections againſt this doctrine ſhould be anſwered: Let us attempt this; and where we cannot extricate ourſelves from difficulties which may be thrown in, let us honeſtly acknowledge ignorance.

65. α. If water, with a very ſmall proportion of oils and ſalts from the earth, proves a fit nouriſhment for vegetables, ſuch a liquor as the fluid of the nerves has been deſcribed (§ 56.) may not be unfit for repairing the waſte in animals.

β. The ſlow continual motion of this nervous fluid (§ 58. 59.) to the moſt minute parts of the body (§ 10.) is well enough calculated to

ſupply the particles that are conſtantly worn off from the ſolids by the circulation of the liquors and neceſſary actions of life.

γ. The greater proportional ſize of the *encephalon* in young creatures than in adults, ſeems calculated for their greater proportional growth: For the younger the animal is, the larger *encephalon* and ſpeedier growth it has.

δ. A palſy and atrophy of the members generally accompanying each other, ſhew, that nouriſhment, ſenſation, and motion, depend on the ſame cauſe.

ε It was ſaid (§ 26.) that the nerves were *principal* inſtruments in nutrition: It was not affirmed, that they were the *ſole* inſtruments; and therefore an *atrophy* may proceed from the compreſſion or other leſion of an artery, without being an objection to the doctrine here laid down.

66. *a.* All objects of ſenſe, when applied to their proper organs, act by impulſe; and this action is capable of being increaſed by increaſing the impelling force. In tangible objects, that is clearly evident; the cloſer they are preſſed to a certain degree, the more diſtinct perception enſues. Odorous particles need the aſſiſtance of air moved rapidly, to affect our noſe: Sapid ſubſtances, that are ſcarce ſufficient to give us an idea of their taſte by their own weight, are aſſiſted by the preſſure of the tongue upon the palate: The rays of light collected drive light bodies before them: Sound communicates a vibration to all bodies in harmonic proportion with it.

The

The impulſes made thus by any of theſe objects on the ſoft pulpy nerves (§ 21.) which are full of liquor, preſſes their ſides or extremities, and their liquor is hindered to flow ſo freely as it did. The canals being all full (§ 58.) this reſiſtance muſt inſtantaneouſly affect the whole column of fluids in the canals that are preſſed, and their origins, and have the ſame effect as if the impulſe had been made upon the origin itſelf. To illuſtrate this by a groſs compariſon: Let any one puſh water out of a ſyringe, through a long flexible pipe fixed to the ſyringe, and he is ſenſible of reſiſtance or a puſh backwards, the moment any one ſtops the orifice of the pipe, or cloſes the ſides of it with his fingers. This impulſe made on the nerves, and thus communicated to their origin, varies according to the ſtrength or weakneſs, the quickneſs or flowneſs, the continuance or ſpeedy removal, the uniformity or irregularity, the conſtancy or alternation, &c. with which objects are applied to the nerves.

b. Whenever any object is regularly applied with due force to a nerve, rightly diſpoſed to be impreſſed by it, and is communicated, as juſt now explained, to the *ſenſorium*, it gives a true and juſt idea of the object to the mind.

c. The various kinds of impulſes which the different claſſes of objects make, occaſion in animals, which ought to have accurate perceptions of each object, a neceſſity of having the different organs of the ſenſes variouſly modified, ſo that the ſeveral impulſes may be regu-

larly applied to the nerves in each organ; or, in other words, we muſt have different organs of the ſenſes fitted to the different claſſes of objects.

d. As the objects have one common property of impulſe, ſo all the organs have moſt of the properties of the organ of touching in common with the *papillae* of the ſkin. In the noſe and tongue, this is evident: In ſome operations of the eyes we can alſo perceive this; as we may likewiſe do in ſome caſes where matter is collected in the internal ear.

e. Theſe properties common to the different objects and organs occaſion frequently uncommon effects in the application of an object to an organ proper to another object of ſenſation; for ſometimes we have the ſame idea as if the object had been applied to its own proper organ: At other times the object is as it were changed, and we have the idea as if the organ had had its own proper object applied to it. Thus, for example, light is the proper object to be applied to the eye, to give us any idea of colours; yet when all light is excluded from the eyes, an idea of light and colours may be excited in us by couching, ſneezing, rubbing, or ſtriking the eye ball.——A cane vibrating, ſo as not to excite ſound perceptible to the ear, applied to the teeth, raiſes a ſtrong idea of ſound; as a little inſect creeping in the *meatus auditorius* alſo does.—The fingers applied to two rough ſurfaces, rubbing on each other, are ſenſible of the ſound they make; ſurgeons of any practice in

in the cure of fractured bones can bear witneſs to the truth of this.——The fingers dipped in acid and ſeveral other acrid liquors, have a ſenſation very like to taſting.——— Smelling and taſting every body knows are ſubſervient and aſſiſting to each other. From ſuch examples we have further proof of one general cauſe of our ſenſations, to wit, impulſe from the objects; and of ſuch a ſimilarity and relation in the organs, as might give reaſon for imagining that any one of them would be capable of producing the effect of another, if the impulſes of the different objects could be regularly applied to each.——Hence light and ſound may affect inſects and other animals that have not eyes or ears.

f. If the impulſe of an object is applied with due force, but irregularly, a confuſed idea of the object is raiſed. Diſtant objects are confuſed to *myopes*, as very near ones are to *preſbytæ*.

g. If the application of the impulſe is regular, but the force with which it is applied, is too weak, our perception of the object is too faint. One may whiſper ſo low as not to be heard.

h. If the application of objects is too violent, and there is any danger of the tender organs of our ſenſes being hurt or deſtroyed, an uneaſy ſenſation we call pain is raiſed, whatever the organ thus injured is. The object of feeling affects every organ: Thus preſſure, ſtretching, cutting, pricking, acrid ſalts, pungent oils, great heat, violent cold, &c. occaſion pain, where ever they are applied.

Beſides, every particular organ can be affected with pain by the too violent application of its own proper object. Too much light pains the eyes; very loud ſound ſtuns the ears; very odorous bodies and too ſapid objects hurt the noſe and tongue. A pretty ſure proof this, that the objects of our ſenſes all act, and that the organs are all impreſſed, in nearly the ſame way.

i. Since a middle impulſe, neither too ſmall nor too great, is neceſſary for a clear perception of objects, we ſhould often be in danger of not diſtinguiſhing them, if we were not ſubjected to another law, to wit, that numerous impulſes made at once, or in a quick ſucceſſion to each other, increaſe our perceptions of objects. Thus, ſuch ſound as would not be heard on a mountain top, will be diſtinctly heard in a wainſcotted chamber.——We feel much more clearly a tangible object when our finger is drawn along it than when applied with the ſame force, but by a ſingle preſſure, upon it.——We make repeated applications of odorous and ſapid objects, when we wiſh to ſmell or taſte accurately.——The end of the burning ſtick appears much more luminous when quickly whirled in a circle than when at reſt.

k. Whenever the uneaſy ſenſation, *pain*, is raiſed by the too ſtrong application of objects, a ſort of neceſſity is as it were impoſed upon the mind to endeavour to get free of the injuring cauſe, by either withdrawing the grieved part of the body from it, as one retires his hand when his finger is pricked or burnt;

burnt; or the injuring cauſe is endeavoured to be forced from the body, as a *teneſmus* excites the contraction which puſhes acrid *fæces* out of the *rectum*. In both theſe operations, a convulſive contraction is immediately made in the leſed part, or in the neighbourhood of it; and if the irritation is very ſtrong or permanent, the greater part of the nervous ſyſtem becomes affected in that ſpaſmodic or convulſive way.——Is it this neceſſity which obliges the mind to exert herſelf in reſpiration, or in the action of the heart, when the lungs or heart are gorged with blood? or the *iris* to contract the pupil, when the eye is expoſed to ſtrong light? or ſneezing to be performed when the noſe is tickled, *&c.*———Will not a *ſtimulus* of any nerve more readily affect thoſe with which it is any where connected than the other nerves of the body?———May not this ſympathy ſerve as a monitor of the mind rather to employ the organs furniſhed with nerves thus connected, to aſſiſt in freeing her of any uneaſy ſenſation, than to make uſe of any other organs?——Will not this in ſome meaſure account for many ſalutary operations performed in the body before experience has taught us the functions of the organs performing them?

The *niſus* of the mind to free the body of what is in danger of being hurtful, may ſerve to explain the *phænomena* of a great many diſeaſes, when we are acquainted with the diſtribution of the particular nerves; and from this we can underſtand the operation of medicines

medicines that ſtimulate; and may learn how, by exciting a ſharp, but momentary pain, we may free the body of another pain that would be more durable; and that, by having it thus in our power to determine a flow of the liquor of the nerves to any particular part, for the benefit of that part, or the relief of any other diſeaſed part, we can do conſiderable ſervice by a right application of the proper medicines.

l. If a pain-giving cauſe is very violent or long continued, it deſtroys the organs either irrecoverably, or puts them ſo much out of order that they only gradually recover: People have been made blind or deaf for all their lives after a violent effect of light on their eyes, or of a ſound on their ears; and we are frequently expoſed to as much light and ſound as to make us unfit to ſee or hear for a conſiderable time. I would explain this by a ligature put round the tender branch of an herb. This ligature drawn to a certain degree, may weaken the canals ſo as to be unfit for the circulation of the juices a good while, till they are gradually explicated and made firm by theſe juices: A ſtricter ligature would diſorder the ſtructure of the fibres ſo much, that the liquors could not recover them. The analogy is ſo plain, that it needs no commentary.———Thus the influence of a nerve tied with an artery in the operation of an aneuriſm may ceaſe for ſome time, but be afterwards recovered.

67. 1. In applying the fluid of the nerves to the action of muſcles, it was ſaid, that the

the natural or involuntary contraction of muſcles was the *niſus* which the nervous fluid flowing conſtantly into the muſcular fibres makes to diſtend theſe fibrils, by enlarging their tranſverſe diameters and ſhortening their axes; and that voluntary contraction was owing to a greater quantity of that nervous liquor determined towards the muſcle to be put in action, and poured with greater *momentum* into the muſcular fibrils, by the power of the mind willing to make ſuch a muſcle to act, or obliged to do it by an irritating pain-giving cauſe (§ 66. *k.*)

2. Some object to this account of muſcular motion, that if there is no outlet for the liquor ſuppoſed to be poured into muſcular fibres, muſcles would always be in a ſtate of contraction, which they are not; and if there is a paſſage from the fibrils, the liquor would flow out as faſt as it was thrown in; and therefore no diſtenſion of the fibres or contraction of the muſcles could be made.

3. In anſwer to this objection, it is obſerved, that notwithſtanding the evident outlet from the arteries into the veins, yet the arteries are diſtended by the *ſyſtole* of the heart, or any other cauſe increaſing the *momentum* of the blood.

4. It has been alſo objected to (§ 1.) that, if it was true, the volume of the muſcle in contraction neceſſarily would be conſiderably increaſed by ſo much liquor poured into its fibrils; whereas it does not appear, by any experiment

experiment, that the volume of a muſcle is increaſed by its being put into action.

5. To this it has been anſwered, 1. That when the axes of muſcular fibres are ſhortened, and their tranſverſe diameters are enlarged, the capacities of their fibres, and conſequently their volume, may not be changed, the diminution one way balancing the increaſe in the other. 2. That the ſpaces between the muſcular fibres are ſufficient to lodge theſe fibres when they ſwell, during the contraction of a muſcle, without any addition to its bulk; and that it plainly appears that theſe ſpaces between the fibrils are thus occupied, by the compreſſion which the larger veſſels of muſcles, which run in thoſe ſpaces, ſuffer during the action of the muſcle; it is ſo great as to drive the blood in the veins with a remarkable accelerated velocity

6. Another objection to the action of muſcles being owing to the influx of a fluid into their fibrils is, That muſcular fibres are diſtractile, or capable of being ſtretched; and therefore, when a fluid is poured into their hollow fibrils, they would be ſtretched longitudinally, as well as have their tranſverſe diameters increaſed; that is, a muſcle would become longer, as well as thicker, when it is put into action; whereas it is certainly known that a muſcle is ſhortened while it acts.

7. In anſwer to this, it has been remarked, That though muſcular fibrils are diſtractile, yet they will not yield to, or be ſtretched by every force, however ſmall, that might be applied to them. A cord that can be ſtretch-

ed

ed in length by the weight of a pound or two, would not yield in the leaſt to an ounce or two; and it muſt likewiſe be obſerved, that gradually as any body is ſtretched, its reſiſtance to the ſtretching force increaſes. A rope may be ſtretched to a certain length by a pound weight appended to it, which would require two pounds to ſtretch it very little further; and therefore the general obſervation of animal fibres being diſtractile, cannot be a reaſonable objection to the account of muſcular motion above mentioned, unleſs a proof is brought that the force which the liquid of the nerves muſt exert upon each fibre of a muſcle, in order to make it act, is capable of diſtracting or ſtretching the fibres; which has not yet been attempted to be proved.—— It would appear from the pain cauſed by too great an effort of muſcles, eſpecially in weak people, that muſcular fibres can bear very little diſtraction without danger of a ſolution of continuity.

8. Muſcles ceaſing to act when their arteries are tied or cut, and being brought into motion by injecting liquors into the arteries even of a dead animal, has been mentioned as objections to the nervous influence cauſing their contractions.

To the firſt of theſe experiments it may be anſwered, That the tying or cutting of the nerves ſooner produces the effect of making the contraction ceaſe than ſtopping the influx of the arterious blood does; and it will be univerſally allowed, that the influx of blood into

into muſcles is neceſſary for performing their functions right.

Whoever obſerves the motion which injecting water or any other liquor into the arteries of a dead animal, cauſes in its muſcles, will not compare it to what contraction, whether voluntary or excited by irritation, he may ſee in a living one.

9. If muſcular motion depends on the influx of the nervous liquid, the inſtantaneous contraction of a muſcle, when the mind wills to make it act, will be eaſily underſtood from the nerves being always full of their liquor (§ 58. 66. *a*).

10. If either the nerves of any muſcle do not furniſh a ſufficient quantity of their liquor, or if the fibres of a muſcle become too eaſily diſtractile, ſuch a muſcle will be unactive or paralytic.

11. If too great a quantity of the liquor of the nerves is determined to a muſcle or muſcles, by any cauſe which the mind cannot command, ſuch muſcle or muſcles will be convulſed.

12. If the motion of the liquid of the nerves is not uniform, but by diſeaſe becomes irregular, an alternate relaxation and contraction of muſcles may be the conſequence. Hence trembling *palſies*, *chorea Sancti Viti*, &c. Hence alſo the convulſive tremors which animals have when they loſe much blood.

13. Though the nerves may not furniſh ſo much liquor as may be ſufficient to make muſcles contract with ſtrength enough to overcome

come the reſiſtances to their actions, yet there may be a ſufficient quantity of liquor in the nerves to allow the impreſſions of objects to be conveyed to the *ſenſorium*. This may be one cauſe of a member's being ſometimes ſenſible after it cannot be moved.

14. Unleſs the liquor of the nerves acquires ſome energy in the brain, which we have no reaſon to think the circulation of the fluids in the veſſels can give it, or unleſs it has other properties than what we can diſcover in it, or unleſs there is an agent regulating its *momentum* and courſe to different parts which we are not conſcious of; if ſome of theſe, I ſay, do not obtain, the action of the heart continuing of equal force to propel our liquors, notwithſtanding all the reſiſtances that are to it, is not to be explained.

15. All muſcles, but eſpecially the heart, continue to contract in an irregular way, after they are cut away from the animal to whom they belonged; which may be owing to the liquors continuing to flow in the ſmall veſſels, and being poured irregularly into the muſcular *fibrillæ*.

16. It is ſaid that a muſcle cut out of the body continues ſome time to be capable of contraction; whereas by tying its arteries or nerves, while it is otherwiſe entire in the body, it loſes its contracting power, which therefore does not depend on theſe organs, the arteries or nerves.

The loſs of the power of acting when the arteries or nerves are tied while the muſcle is

is in the body, is denied by ſome who made the trial, and it might be expected that the motion of a muſcle would be more conſpicuous where there is no reſiſtance to it, as is the caſe when it is cut away from all the parts it is connected with, than when its connection remains with parts reſiſting its contractile efforts.

17. After the heart, or any other muſcle cut away from an animal, has ceaſed to contract, its contraction may again be reſtored, by breathing upon it, or pricking it with any ſharp inſtrument. That heat or pricking ſhould, by their *ſtimulus* (§ 66. *k.*) occaſion contraction in a living creature, may be underſtood; but how they ſhould have the ſame effect in a muſcle ſeparated from an animal, I know not.

18. Some have thought the *ganglions* of nerves (§ 18. 19. 20.) to be glandular, and to perform a ſecretion.—Others, from their firm texture, ſuppoſe them to be muſcular, and to ſerve to accelerate the motion of the liquor in the nerves which proceed from them; but as no proof is offered of either of theſe opinions, they cannot be maintained.——Others would make them ſerve, 1. To divide a ſmall nerve into many nerves, and by theſe means to increaſe the number of nervous branches. 2. To make nerves come conveniently by different directions to the parts to which they belong. 3. To reunite ſeveral ſmall nervous fibres into one large nerve.—Since no proof is brought that theſe three things cannot be done without the interpoſition of a *ganglion*, but on the contrary, we ſee them performed where there

are

are no *ganglions*, we muſt continue to acknowledge ignorance concerning the uſes of theſe knotes, the *ganglions*.

Of the PARTICULAR NERVES.

'TIS generally ſaid, that there are forty pair of nerves in all; of which ten come out from the *encephalon*, and the other thirty have their origin from the *ſpinal marrow*.

Of the ten pair of nerves which come from the *encephalon*, the firſt is the *OLFACTORY*, which long had the name of the *mammillary proceſſes* of the brain, becauſe in the brutes, cows and ſheep, which were moſt commonly diſſected by the antients, the anterior ventricles of the brain are extended forwards upon theſe nerves, and adhere ſo firmly to them, that they ſeem to make the upper ſide of the nerves. Each of them being large, where it begins to be ſtretched out, and gradually becoming ſmaller as it approaches the cribriform bone, was imagined to reſemble a nipple. Thoſe who miſtook the ventricles for part of the nerves, obſerving the cavity in them full of liquor, concluded, that theſe olfactory nerves ſerved to convey the ſuperfluous moiſture of the brain to the holes of the ethmoid bone through which it paſſed into the noſe. But in man, the ventricles of whoſe brain are not thus extended forwards, theſe nerves are ſmall, long, and without any cavity, having

having their origin from the *corpora ſtriata*, near the part where the internal carotid arteries are about to ſend off their branches to the different parts of the brain; and in their courſe under the anterior lobes of the brain, which have each a depreſſion made for lodging them, the human olfactory nerves become larger, till they are extended to the cribriform bone; where they ſplit into a great number of ſmall filaments, to paſs through the little holes in that bone; and being joined by a branch of the fifth pair of nerves, are ſpread on the membrane of the noſe.

The tender ſtructure and ſudden expanſion of theſe nerves on ſuch a large ſurface, render it impoſſible to trace them far; which has made ſome authors deny them to be nerves: But when we break the circumference of the *cribriform lamella*, and then gently raiſe it, we may ſee the diſtribution of the nerves ſome way on the membrane of the noſe.

The contrivance of defending theſe long ſoft nerves from being too much preſſed by the anterior lobes of the brain under which they lie, is ſingular; becauſe they have not only the prominent orbitar proceſſes of the frontal bone to ſupport the brain on each ſide, with the veins going into the longitudinal *ſinus*, and other attachments bearing it up, but there is a groove formed in each lobe of the brain itſelf for them to lodge in.—Their ſplitting into ſo many ſmall branches before they enter the bones of the ſcull, is likewiſe peculiar to them; for generally the nerves come from the brain in diſgregated filaments, and unite into cords,

as

as they are going out at the holes of the bones. This contrivance is the beſt for anſwering the purpoſe they are deſigned for, of being the organ of ſmelling; for had they been expanded upon the membrane of the noſe into a medullary web, ſuch as the optic nerve forms, it would have been too ſenſible to bear the impreſſions of ſuch objects as are applied to the noſe; and a diſtribution in the more common way, of a cord ſending off branches, would not have been equal enough for ſuch an organ of ſenſation.

The 2*d* pair of nerves, the *OPTIC*, riſing from the *thalami nervorum opticorum*, make a large curve outwards, and then run obliquely inwards and forwards, till they unite at the fore part of the *ſella turcica*; then ſoon divide, and each runs obliquely forwards and outwards to go out at its proper hole in the ſphenoid bone, accompanied with the ocular artery, to be extended to the globe of the eye, within which each is expanded into a very fine cup-like web, that lines all the inſide of the eye as far forwards as the *ciliary circle*, and is univerſally known by the name of *retina*.

Though the ſubſtance of this pair of nerves ſeems to be blended at the place where they are joined; yet obſervations of people whoſe optic nerves were not joined, and of others who were blind of one eye from a fault in the optic nerve, or in thoſe who had one of their eyes taken out, make it appear, that there is no ſuch intimate union of ſubſtance; the optic nerve of the affected ſide only being waſted, while the other was large and plump. And the

ſame

ſame obſervations are contradictory to the doctrine of a decuſſation of all the nerves (§ 8.); for the diſeaſe could be traced from the affected eye to the origin of the nerve on the ſame ſide. In many fiſhes indeed, the doctrine of decuſſation is favoured; for their optic nerves plainly croſs each other, without any union at the part where they are joined in men and moſt quadrupeds.

Theſe people whoſe optic nerves were not joined, having neither ſeen objects double, nor turned their eyes different ways, is alſo a plain proof, that the conjunction of the optic nerves will not ſerve to account for either the uniform motions of our eyes, or our ſeeing objects ſingle with two eyes, though it may be one cauſe of the remarkable ſympathy of the one eye with the other in many diſeaſes.

The *retina* of a recent eye, without any preparation, appears a very fine web, with ſome blood-veſſels coming from its centre to be diſtributed on it; but, after a good injection of the arteries that run in the ſubſtance of this nerve, as is common to other nerves, it is with difficulty that we can obſerve its nervous medullary ſubſtance.—The ſituation of theſe veſſels in the central part of the optic nerve; the want of medullary fibres here, and the firmneſs of this nerve before it is expanded at its entry into the ball of the eye, may be the reaſon why we do not ſee ſuch bodies, or parts of bodies, whoſe picture falls on this central part of the *retina*.——An inflammation in thoſe arteries of the *retina*, which ſeveral fevers and an *ophthalmia* are generally attended with,

with, may very well account for the tenderneſs in the eyes, and inability to bear the light, which people have in theſe diſeaſes.—The over-diſtenſion of theſe veſſels may likewiſe ſerve to account for the black ſpots obſerved on bright coloured bodies eſpecially, and for that ſmoaky fog through which all objects are ſeen by people in ſome fevers.——If theſe veſſels loſe their tone, and remain preternaturally diſtended, no objects affect our *retina*, though the eye externally appears ſound; or this may be one cauſe of an *amauroſis* or *gutta ſerena*.—From a partial diſtenſion of theſe veſſels, or *paralyſis* of a part of the *retina*, the central part, or the circumference of any other part of objects, may be loſt to one or both eyes.

The *THIRD PAIR* riſe from the anterior part of the *proceſſus annularis*, and piercing the *dura mater* a little before, and to a ſide of the ends of the poſterior clinoid proceſs of the ſphenoid bone, run along the *receptacula*, or *cavernous ſinuſes*, at the ſide of the *ephippium*, to get out at the *foramina lacera*; after which each of them divides into branches, of which one, after forming a little *ganglion*, is diſtributed to the globe of the eye; the others are ſent to the *muſculus rectus* of the *palpebra*, and to the *attollens*, *adductor*, *deprimens*, and *obliquus minor* muſcles of the eye-ball. Theſe muſcles being principal inſtruments in the motions of the eye-lid and eye-ball, this nerve has therefore got the name of the *motor oculi*.——I have frequently obſerved in convulſions the eye-lids widely opened, the *cornea* turned

turned upward and outwards, and the eye-balls ſunk in the orbit; which well deſcribed the conjunct action of the muſcles which this pair of nerves ſerves.—The diſtenſion of a conſiderable branch of the carotid, which paſſes over this nerve near its origin on each ſide, may poſſibly be the reaſon of the heavineſs in the eye-lids and eyes, after drinking hard, or eating much.

The *FOURTH PAIR*, which are the ſmalleſt nerves of any, derive their origin from the back part of the baſe of the *teſtes*; and then making a long courſe on the ſide of the annular protuberance, enter the *dura mater* a little farther back, and more externally than the third part, to run alſo along the *receptacula*, to paſs out at the *foramina lacera*, and to be entirely ſpent on the *muſculi trochleares*, or ſuperior oblique muſcles of the eyes. Theſe muſcles being employed in performing the rotatory motions, and the advancement of the eye-balls forward, by which ſeveral of our paſſions are expreſſed, the nerves that ſerve them have got the name of *PATHETICI*.——Why theſe ſmall nerves ſhould be brought ſo far to this muſcle, when it could have been ſupplied eaſily by the *motor oculi*, I know not.

The *FIFTH PAIR* are large nerves, riſing from the annular proceſſes where the medullary proceſſes of the *cerebellum* join in the formation of that *tuber*, to enter the *dura mater* near the point of the petrous proceſs of the temporal bones; and then ſinking cloſe by the *receptacula* at the ſides of the

ſella

ſella turcica, each becomes in appearance thicker, and goes out of the ſkull in three great branches.

The firſt branch of the fifth is the *OPHTHALMIC*, which runs through the *foramen lacerum* to the orbit, having in its paſſage thither a connection with the ſixth pair. It is afterwards diſtributed to the ball of the eye with the third; to the noſe, along with the olfactory, which the branch of the fifth that paſſes through the *foramen orbitarium internum* joins, as was already mentioned in the deſcription of the firſt pair. This ophthalmic branch likewiſe ſupplies the parts at the internal *canthus* of the orbit, the *glandula lacrymalis*, fat, membranes, muſcles, and teguments of the eye-lids; its longeſt fartheſt extended branch paſſing through the *foramen ſuperciliare* of the *os frontis*, to be diſtributed to the fore-head.

The ſmall fibres which this firſt branch of the fifth and the third pair of nerves ſend to the eye-ball, being ſituated on the optic nerve, and, after piercing the ſclerotic coat, running along the choroid coat on the outſide of the *retina* in their courſe to the *uvea* or *iris*, may be a cauſe of the ſympathy between the optic nerve and the *uvea*; by which we more readily acquire the habit of contracting the *iris*, and thereby leſſen the pupil, when too ſtrong light is excluded; and, on the contrary, enlarge the pupil, when the light is too faint.—This, with the ſympathy which muſt ariſe from ſome of the nerves of the membrane of the

 noſtrils,

noſtrils, being derived from this firſt branch of the fifth pair of nerves, may alſo be the cauſe, why an irritation of the *retina*, by too ſtrong light, may produce ſneezing, as if a *ſtimulus* had been applied to the membrane of the noſe itſelf;——why preſſing the internal *canthus* of the orbit, ſometimes ſtops ſneezing;——why irritation of the noſe or of the eye cauſes the eye-lids to ſhut convulſively, and makes the tears to flow plentifully; and why medicines put into the noſe, do often great ſervice in diſeaſes of the eyes.—In the megrim all the branches of the nerve diſcover themſelves to be affected: for the forehead is racked with pain, the eye-ball is pained, and feels as if it was ſqueezed, the eye-lids ſhut convulſively, the tears trickle down, and an uneaſy heat is felt in the noſe. Hence we can underſtand where external medicines will have the beſt effect, when applied to remove this diſeaſe, to wit, to the membrane of the noſe, and to the forehead:——why alternate preſſure near the ſuperciliary hole of the frontal bone, or ſneezing, ſometimes gives immediate relief in the megrim;—why the ſight may be loſt by an injury done to the *ſupra orbitar* branch;—how it may be reſtored by agitation of that branch of this nerve.

The ſecond branch of the fifth pair of nerves may be called *MAXILLARIS SUPERIOR*, from its ſerving principally the parts of the upper jaw. It goes out at the round hole of the ſphenoid bone, and ſends immediately one branch into the channel on the top of the *antrum maxillare*; the membrane

of

of which and the upper teeth are ſupplied by it in its paſſage. As this branch is about to go out at the *foramen orbitarium externum*, it ſends a nerve through the ſubſtance of the *os maxillare* to come out at *Steno*'s duct, to be diſtributed to the fore part of the palate; and what remains of it eſcaping at the *external orbitar* hole, divides into a great many branches, that ſupply the cheek, upper lip, and noſtril.—The next conſiderable branch of the *ſuperior maxillary* nerve, after giving branches which are reflected through the ſixth hole of the *ſphenoid* bone, to join the intercoſtal where it is paſſing through the ſkull with the carotid artery, and the *portio dura* of the ſeventh pair, as it paſſes through the *os petroſum*, is ſent into the noſe by the hole common to the palate and ſphenoidal bone; and the remaining part of this nerve runs in the *palato-maxillaris* canal, giving off branches to the temples and pterygoid muſcles, and comes at laſt into the palate to be loſt.———Hence, the ach in the teeth of the upper jaw occaſions a gnawing pain deep ſeated in the bones of the face, with ſwelling in the eye-lids, cheek, noſe, and upper lip; and on the other hand, an inflammation in theſe parts, or a megrim, is often attended with ſharp pain in the teeth.—Hence, an obſtruction in the duct of the maxillary ſinus, which obliges the liquor ſecreted there to find out a preternatural route for itſelf, may be occaſioned by the pain of the teeth.——Hence, the upper lip often ſuffers when the palate or noſe is ulcerated.

The third or *MAXILLARIS INFERIOR* branch of the fifth pair going out at the oval hole of the ſphenoid bone, ſerves the muſcles of the lower jaw, and the muſcles ſituated between the *os hyoides* and *jaw*: All the ſalivary glands, the *amygdalæ*, and the external ear, have branches from it: It has a large branch loſt in the tongue, and ſends another through the canal in the ſubſtance of the lower jaw to ſerve all the teeth there, and to come out at the hole in the fore part of the jaw, to be loſt in the chin and under lip.——Hence a convulſive contraction of the muſcles of the lower jaw, or the mouth's being involuntarily ſhut, a great flow of ſpittle or ſalivation, a pain in the ear, eſpecially in deglutition, and a ſwelling all about the throat, are natural conſequences of a violent irritation of the nerves of the lower teeth in the toothach; and pain in the teeth and ear, is as natural a conſequence of an *angina*.——Hence alternate preſſure on the chin may ſometimes relieve the violence of a toothach.——Hence deſtroying the nerves of a tooth by actual or potential cauteries, or pulling a carious tooth, ſo often removes immediately all theſe ſymptoms.——Hence no cure is to be found for ſome ulcers in the upper or lower jaw, but by drawing a tooth.——Hence in cancers of the upper lip, the ſalivary glands are in danger of being affected, or the diſeaſe may be occaſioned to the lip by its beginning in the glands.——Perhaps the ſympathy of the organs of taſting and ſmelling may

in

in ſome meaſure depend on their both receiving nerves from the fifth pair.

The *SIXTH PAIR*, which is the ſmalleſt except the fourth, riſes from the fore part of the *corpora pyramidalia*; and each entering the *dura mater* ſome way behind the poſterior clinoid proceſs of the ſphenoid bone, has a long courſe below that membrane, and within the *receptaculum* at the ſide of the *ſella turcica*, where it is immerſed in the blood of the receptacle; but for what purpoſe I am ignorant. It goes afterwards out at the *foramen lacerum* into the orbit, to ſerve the abductor muſcle of the eye.——A defect in this nerve may therefore be one cauſe of a *ſtrabiſmus*.—In the paſſage of this nerve below the *dura mater*, it lies very contiguous to the internal carotid artery, and to the ophthalmic branch of the fifth pair of nerves. At the place where the ſixth pair is contiguous to the carotid, a nerve either goes from each of them in an uncommon way, to wit, with the angle beyond where it riſes obtuſe, to deſcend with the artery, and to form the beginning of the intercoſtal nerve, according to the common deſcription; or, according to other authors, this nerve comes up from the great *ganglion* of the *intercoſtal*, to be joined to the ſixth here.

The arguments for this latter opinion are, That, according to the common doctrine, this beginning of the *intercoſtal* nerve, as it is called, would riſe in a manner not ſo ordinary in nerves. In the next place, it is obſerved, that the ſixth pair is larger nearer to the orbit, than it is before it comes to the place where

this nerve is ſaid to go off; and therefore it is more probable, that it receives an addition there, rather than gives off a branch. *Laſtly*, It is found, that upon cutting the *intercoſtal* nerves of living animals, the eyes plainly were affected; they loſt their bright water; the gum, or gore, as we call it, was ſeparated in greater quantity; the pupil was more contracted; the cartilaginous membrane, at the internal *canthus*, came more over the eye; and the eye-ball itſelf was diminiſhed.

To this it is anſwered, in defence of the more common doctrine, 1*ſt*, That other branches of nerves go off in a reflected way, as well as this does, ſuppoſing it to be the beginning of the intercoſtal; and that the reflection would rather be greater, if it is thought to come up from the intercoſtal to the ſixth. 2*dly*, It is denied that this nerve is for ordinary thicker at its fore than its back part; and if it was ſuppoſed to be thickeſt nearer to the orbit, the concluſion made above could not be drawn from this appearance, becauſe other nerves enlarge ſometimes where there is no addition made to them, as in the inſtance already mentioned of the trunk of the fifth pair while below the *dura mater*. 3*dly*, The experiments on living animals ſhew indeed, that the eyes are affected upon cutting the intercoſtal nerve, but not in the way which might have been expected, if the *intercoſtal* had furniſhed ſuch a ſhare of the nerve that goes to the *abductor* muſcle of the eye; for it might have been thought, that this muſcle would have been ſo much weakened immediately upon cutting the

inter-

intercoſtal, that its antagoniſt the *abductor* would have greatly prevailed over it, and have turned the eye ſtrongly in towards the noſe; which is not ſaid to be a conſequence of this experiment. So that the arguments are ſtill equivocal; and more obſervations and experiments muſt be made, before it can be determined with certainty, whether the ſixth pair gives or receives a branch here. In the mean time, I ſhall continue to ſpeak about the origin of the *intercoſtal* with the generality of anatomiſts.

At this place where the intercoſtal begins, the fifth pair is contiguous and adherent to the ſixth; and it is generally ſaid, that the ophthalmic branch of the fifth gives a branch or two to the beginning of the intercoſtal, or receives ſuch from it. Others deny any ſuch communication between them; and thoſe who affirm the communication confeſs, that in ſome ſubjects they could not ſee it. After examining the nerves here in a great many ſubjects, I cannot determine whether or not there are nervous filaments going from the one to the other. Sometimes I have thought that I traced them evidently; at other times I obſerved that what I diſſected for nervous filaments, was collapſed cellular ſubſtance; and in all the ſubjects where I had puſhed an injection ſucceſsfully into the very ſmall arteries, I could only obſerve a *plexus* of veſſels connecting the one to the other. In any of theſe ways, however, there is as much connection as, we are aſſured from many experiments and obſervations on other nerves, is ſufficient to

make a very great ſympathy among the nerves here.—Poſſibly the appearances in the eyes of dogs, whoſe intercoſtal nerves were cut, might be owing to this ſympathy.

The *SEVENTH PAIR* comes out from the lateral part of the *annular proceſs*, behind where the medullary proceſs of the *cerebellum* are joined to that *tuber*; and each being accompanied with a larger artery than moſt other nerves, enters the *internal meatus auditorius*, where the two large bundles of fibres, of which it appeared to conſiſt within the ſkull, ſoon ſeparate from each other; one of them entering by ſeveral ſmall holes into the *veſtible*, *cochlea*, and *ſemicircular canals*, is ſtretched on this inner *camera* of the ear in a very ſoft pulpy ſubſtance; and being never ſeen in the form of a firm cord, ſuch as the other parcel of this and moſt other nerves become, is called *PORTIO MOLLIS* of the auditory nerve.

The other part of this ſeventh pair paſſes through *Galen's foramen cæcum*, or *Fallopius's aquæduct*, in its crooked paſſage by the ſide of the *tympanum*; in which paſſage, a nerve ſent from the lingual branch of the inferior maxillary nerve, along the outſide of the *tuba Euſtachiana*, and croſs the cavity of the *tympanum*, where it has the name of *chorda tympani*, is commonly ſaid to be joined to it. The very acute angle which this nerve makes with the fifth, or the ſudden violent reflection it would ſuffer on the ſuppoſition of its coming from the fifth to the ſeventh, appears unuſual; whereas, if we ſuppoſe that it comes from the

ſeventh

ſeventh to the fifth, its courſe would be more in the ordinary way, and the *chorda tympani* would be eſteemed a branch of the ſeventh pair going to join the fifth, the ſize of which is increaſed by this acquiſition. This ſmaller bundle of the ſeventh gives branches to the muſcles of the *malleus*, and to the *dura mater*, while it paſſes through the bony crooked canal, and at laſt comes out in a firm chord named *PORTIO DURA*, at the end of this canal, between the *ſtyloid* and *maſtoid* proceſſes of the temporal bone, giving immediately filaments to the little oblique muſcles of the head, and to thoſe that riſe from the ſtyloid proceſs. It then pierces through the parotid gland, and divides into a great many branches, which are diſperſed in the muſcles and teguments that cover all the ſide of the upper part of the neck, the whole face and *cranium*, as far back as the temples, including a conſiderable part of the external ear. Its branches having thus a conſiderable connection with all the three branches of the fifth pair, and with the ſecond cervical, occaſion a conſiderable ſympathy of theſe nerves with it.——Hence, in the toothach, the pain is ſometimes very little in the affected tooth, compared to what it is all along the ſide of the head and in the ear.—Hence probably the relief of the toothach from bliſters applied behind or before the ear, or by a hot iron touching the *antihelix* of the ear. —By this communication or connection poſſibly too it is, that a vibrating ſtring held between one's teeth, gives a ſtrong idea of ſound to the perſon who holds it, which no

body elſe can perceive.——Perhaps too the diſtribution of this nerve occaſions the head to be ſo quickly turned upon the impreſſion of ſound on our ears.

The *EIGHTH PAIR* of nerves riſe from the lateral baſes of the *corpora olivaria* in diſgregated fibres; and as they are entering the anterior internal part of the holes common to the *os occipitis* and *temporum*, each is joined by a nerve which aſcends within the *dura mater* from the tenth of the head, the firſt, ſecond and inferior cervical nerves: This every body knows has the name of the *NERVUS ACCESSORIUS*. When the two get out of the ſcull the *acceſſorius* ſeparates from the eighth, and, deſcending obliquely outwards, paſſes through the *ſterno-maſtoideus* muſcle, to which it gives branches, and afterwards terminates in the *trapezius* and *rhomboid* muſcles of the *ſcapula*. In this courſe it is generally more or leſs joined by the ſecond cervical nerve. ——Why this nerve, and ſeveral others which are diſtributed to muſcles, are made to pierce through muſcles, which they might have only paſſed near to, I do not know.

The large *eighth-pair*, ſoon after its exit, gives nerves to the tongue, *larynx*, *pharynx*, and *ganglion* of the *intercoſtal* nerve, and being disjoined from the ninth and intercoſtal, to which it adheres cloſely ſome way, runs ſtreight down the neck behind the internal jugular vein, and at the external ſide of the carotid artery. As it is about to enter the *thorax*, a large nerve goes off from the eighth

of

of each ſide: This branch of the right ſide turns round from the fore to the back part of the ſubclavian artery, while the branch of the left ſide turns round the great curve of the *aorta*, and both of them mounting up again at the ſide of the *œſophagus*, to which they give branches, are loſt at laſt in the *larynx*. Theſe are called the *RECURRENT* nerves, which we are deſired to ſhun in the operation of *bronchotomy*, though their deep ſituation protects them ſufficiently.—The muſcles of the *larynx* being in a good meaſure ſupplied with nerves from the recurrents, it is to be expected, that the cutting of them will greatly weaken the voice, though it will not be entirely loſt, ſo long as the ſuperior branches of the eighth pair are entire.—Why the recurrent nerves riſe ſo low from the eighth pair to go round a large artery, and to have ſuch a long courſe upwards, I know not.

The eighth pair, above and at or near the place where the recurrent nerves go off from it, or frequently the recurrents themſelves, ſend off ſmall nerves to the *pericardium*, and to join with the branches of the intercoſtal that are diſtributed to the heart; but their ſize and ſituation are uncertain.

After theſe branches are ſent off, the *par vagum* on each ſide deſcends behind the great branch of the *trachea*, and gives numerous filaments to the lungs, and ſome to the heart in going to the *œſophagus*. The one of the left ſide running on the fore-part of the *œſophagus*, communicates by ſeveral branches with the right one in its deſcent to be diſtributed

buted to the ſtomach: The right one gets behind the *æſophagus*, where it ſplits and rejoins ſeveral times before it arrives at the ſtomach, to which it ſends nerves; and then being joined by one or more branches from the left-trunk, they run towards the cæliac artery, there to join into the great *ſemilunar ganglion* formed by the two intercoſtals.

From the diſtribution of this *par vagum*, we may learn how tickling the *fauces* with a feather or any ſuch ſubſtance, excites a *nauſea* and inclination to vomit;——why coughing occaſions vomiting, or vomiting raiſes a cough.——Hence we ſee how the nervous *aſthma* and the *tuſſis convulſiva*, chincough, are attended with a ſtraitening of the *glottis*;—why food difficult to digeſt occaſions the *aſthma* to weakly people; and why *emetics* have frequently cured the *aſthma* very ſpeedily;——why an attempt to vomit is ſometimes in danger of ſuffocating *aſthmatic* people;—why the ſuperior orifice of the ſtomach is ſo ſenſible, as to be looked on as the ſeat of the ſoul by ſome;——why people ſubject to diſtenſions of the ſtomach, have ſo often the ſenſation of balls in their breaſts and throats;——why the *globus hyſtericus* is ſo often attended with a violent ſtrangulation at the *glottis*.

The *NINTH PAIR* of nerves comes from the inferior part of the *corpora pyramidalia*, to go out of the ſcull at their proper holes of the occipital bone. After their egreſs they adhere for ſome way firmly to the eighth and intercoſtal; and then ſending a branch, that in many ſubjects is joined with

branches

branches of the firſt and ſecond cervical nerves, to be diſtributed to the thyroid gland and muſcles on the fore-part of the *trachea arteria*, the ninth is loſt in the muſcles and ſubſtance of the tongue. Some have thought this nerve, and others have eſteemed the third branch of the fifth pair of nerves, to be the proper guſtatory nerve. I know no obſervation or experiments to prove either opinion, or to aſſure us, that both nerves do not ſerve for taſting and for the motion of the tongue.———May not the diſtribution of this nerve to the muſcles below, as well as above the *os hyoides*, contribute to their acting more uniformly in depreſſing the lower jaw or head?

The *TENTH PAIR* riſes in ſeparate threads from the ſides of the *ſpinal marrow*, to go out between the *os occipitis* and *firſt vertebra* of the neck. After each of them has given branches to the great ganglion of the intercoſtal, 8th, 9th, and 1ſt cervical nerves, it is diſtributed to the ſtreight, oblique, and ſome of the extenſor muſcles of the head. Whether the name of the tenth of the head, or of the firſt vertebral, ought to be given to this pair of nerves, is of no ſuch conſequence as to deſerve a debate, tho' it has ſome of the marks of the ſpinal nerves, to wit, its being formed of filaments proceeding from both the fore and back part of the *medulla*, and a little *ganglion* being formed where theſe filaments meet.

In the deſcription of the ſixth pair, I followed the uſual way of ſpeaking among anatomiſts, and called that the beginning of the intercoſtal

tercoſtal nerve which comes out of the ſcull; and therefore ſhall here ſubjoin a curſory deſcription of this nerve, notwithſtanding its much larger part is compoſed of nerves coming out from the *ſpinal marrow*. There is no greater incongruity in point of method to ſay, that the nerve we are deſcribing receives additions from others that have not been deſcribed, than it is to repeat in the deſcription of a great many nerves, that each of them gives branches to form a nerve which we are ignorant of; which is all the difference between deſcribing the intercoſtal before or after the ſpinal nerves.

The branch reflected from the ſixth pair, joined poſſibly by ſome filaments of the *opthalmic* branch of the fifth, runs along with the internal carotid artery, through the crooked canal formed for it in the temporal bone, where the little nerve is very ſoft and pappy, and in ſeveral ſubjects divides and unites again, and is joined by one or more branches from the fifth, particularly of its ſuperior maxillary branch, before it comes out of the ſcull. May the compreſſion of this nerve by the carotid artery when ſtretched during the *ſyſtole*, contribute to the *diaſtole* of the heart? As ſoon as the nerve eſcapes out of this bony canal, it is connected a little way with the eighth and ninth; then ſeparating from theſe, after ſeeming to receive additional nerves from them, it forms a large *ganglion*, into which branches form the tenth of the head, and from the firſt and ſecond cervical, enter. From this ganglion the nerves come out again ſmall to run

down

down the neck along with the carotid artery, communicating by branches with the cervical nerves, and giving nerves to the muſcles that bend the head and neck. As the intercoſtal is about to enter the *thorax*, it forms another ganglion, from which nerves are ſent to the *trachea* and to the heart; theſe deſigned for the heart joining with the branches of the eighth, and moſt of them paſſing between the two great arteries and the auricles, to the ſubſtance of that muſcle. The intercoſtal after this conſiſting of two branches, one going behind, and the other running over the fore-part of the ſubclavian artery, forms a new ganglion where the two branches unite below that artery, and then deſcending along the ſides of the *vertebræ* of the *thorax*, receives branches from each of the dorſal nerves; which branches appearing to come out between the ribs, have given the name of intercoſtal to the whole nerve. Where the addition is made to it from the fifth dorſal nerve, a branch goes off obliquely forwards; which being joined by ſuch branches from the ſixth, ſeventh, eighth, and ninth dorſal, an anterior trunk is formed, and paſſes between the fibres of the *appendix muſculoſa* of the diaphragm, to form, along with the other intercoſtal and the branches of the eighth pair, a large ſemilunar ganglion, ſituated between the cæliac and ſuperior meſenteric arteries; the roots of which are as it were involved in a ſort of nervous net-work of this ganglion, from which a great number of very ſmall nervous threads run out to be extended on the ſurface of all the branches of

thoſe

thoſe two arteries, ſo as to be eaſily ſeen when any of the arteries are ſtretched, but not to be raiſed from them by diſſection; and thus the *liver*, *gall-bladder*, *duodenum*, *pancreas*, *ſpleen*, *jejunum*, *ilium*, and a large ſhare of the *colon*, have their nerves ſent from this great *ſolar ganglion* or *plexus*.—May the periſtaltic motion of the inteſtines depend in ſome meaſure on the paſſage of the intercoſtal nerves through the diaphragm?

Several fibres of this ganglion, running down upon the *aorta*, meet with other nerves ſent from the poſterior trunk of the intercoſtal, which continues its courſe along the ſides of the *vertebræ*, they ſupply the *glandulæ renales*, kidneys, and *teſtes* in men, or *ovaria* in women; and then they form a network upon the inferior meſenteric artery where the nerves of the two ſides meet, and accompany the branches of this artery to the part of the *colon* that lies in the left ſide of the belly, and to the *rectum*, as far down as to the lower part of the *pelvis*.

The intercoſtal continuing down by the ſide of the *vertebræ* of the loins, is joined by nerves coming from between theſe *vertebræ*, and ſends nerves to the organs of generation and others in the *pelvis*, being even joined with thoſe that are ſent to the inferior extremities.

The almoſt univerſal connection and communication which this nerve has with the other nerves of the body, may lead us to underſtand the following, and a great many more *phænomena*.—Why tickling the noſe cauſes ſneezing.——Why the too great quantity of bile in the *cholera* occaſions vomiting as well as purging.

purging.—Why people vomit in colics, in inflammations, or other irritations of the liver, or of the ducts going from it and the gall-bladder.——Why a ſtone in the kidneys, or ureters, or any other cauſe irritating thoſe organs, ſhould ſo much more frequently bring on vomiting and other diſorders of the ſtomach, than the ſtone, or any other ſtimulating cauſe in the bladder does.—Why vomiting is a ſymptom of danger after child-birth, lithotomy, and other operations on the parts in the *pelvis*.—Why the obſtructions of the *menſes* are capable of occaſioning ſtrangulations, belching, colics, ſtomach-aches, and even convulſions in the extremities.——Why veſicatories, applied from the ears to the clavicles of children labouring under the *tuſſis convulſiva*, are frequently of great ſervice.—Why worms in the ſtomach or guts excite an itching in the noſe, or grinding of the teeth.—Why irritations in the bowels or the belly occaſion ſometimes univerſal convulſions of the body.

The *ſpinal* nerves riſe generally by a number of diſgregated fibres from both the fore and back part of the *medulla ſpinalis*, and ſoon after form a little knot or ganglion, where they acquire ſtrong coats, and are extended into firm cords. They are diſtinguiſhed by numbers, according to the *vertebræ* from between which they come out; the ſuperior of the two bones, forming the hole through which they paſs, being the one from which the number is applied to each nerve. There are generally ſaid to be *thirty pair* of them; ſeven of which come out between the

vertebræ

vertebræ of the *neck*, twelve between thoſe of the *back*, five between thoſe of the loins, and ſix from the *falſe vertebræ*.

The *FIRST CERVICAL* pair of nerves comes out between the firſt and ſecond *vertebræ* of the neck; and having given branches to join with the tenth pair of the head, the ſecond cervical and intercoſtal, and to ſerve the muſcles that bend the neck, it ſends its largeſt branches backwards to the extenſor muſcles of the head and neck; ſome of which piercing through theſe muſcles, run up on the *occiput* to be loſt in the teguments here; and many fibres of it advance ſo far forward as to be connected with the *fibrils* of the firſt branch of the fifth pair of the head, and of the *portio dura* of the *auditory nerve*.——— Hence poſſibly it is that a *clavus hyſtericus* changes ſuddenly ſometimes from the forehead to a violent pain and ſpaſm in the back-part of the head and neck.

The *SECOND CERVICAL* is ſoon joined by ſome branches to the ninth of the head and intercoſtal, and to the firſt and third of the neck; then has a large branch that comes out at the exterior edge of the *ſterno-maſtoideus* muſcle, where it joins with the *acceſſorius* of the eighth pair; and is afterwards diſtributed to the *platyſma myoides*, teguments of the ſide of the neck and head, parotid gland, and external ear, being connected to the *portio dura* of the auditory nerve, and to the firſt cervical. The remainder of this ſecond cervical is ſpent on the *levator ſcapulæ* and the extenſors of the neck and head. Generally

nerally a large branch is here ſent off to join the *acceſſorius* of the eighth pair, near the ſuperior angle of the *ſcapula*.

To the irritation of the branches of this nerve it probably is, that, in an inflammation of the parotid gland, the neck is pained ſo far down as the clavicle, the head is drawn towards the ſhoulder of the affected ſide, and the chin is turned to the other ſide.——In opening the external jugular vein, no operator can promiſe not to touch ſome of the cutaneous branches of this nerve with the lancet; which occaſions a ſharp pricking pain in the mean time, and a numbneſs of the ſkin near the orifice for ſome time after.

The *THIRD PAIR* of the neck paſſes out between the third and fourth cervical *vertebræ*; having immediately a communication with the ſecond, and ſending down a branch, which being joined by a branch from the fourth cervical, forms the *PHRENIC* nerve. This deſcending enters the *thorax* between the ſubclavian vein and artery; and then being received into a groove formed for it in the *pericardium*, it has its courſe along this *capſula* of the heart, till it is loſt in the middle part of the diaphragm. The right phrenic has a ſtreight courſe; but the left one is obliged to make a conſiderable turn outwards to go over the prominent part of the *pericardium*, where the point of the heart is lodged. Hence in violent palpitations of the heart, a pungent acute pain is felt near the left orifice of the ſtomach.—The middle of the diaphragm ſcarce could have been ſupplied

plied by any other nerve which could have had ſuch a ſtreight courſe as the *phrenic* has. If the ſubclavian artery and vein have any effect upon this nerve, I do not know it.

The other branches of the third cervical nerve are diſtributed to the muſcles and teguments at the lower part of the neck and top of the ſhoulder. No wonder then that an inflammation of the liver or ſpleen, an abſceſs in the lungs adhering to the diaphragm, or any other cauſe capable of irritating the diaphragm, ſhould be attended with a ſharp pain on the top of the ſhoulder, as well as wounds, ulcers, &c. of this muſcle itſelf.—If the irritation of this muſcle is very violent, it may occaſion that convulſive contraction of the diaphragm which is called an *hiccough*; and therefore an hiccough in an inflammation of the liver has been juſtly declared to be an ill ſymptom.

An irritation of the thoracic nerves which produces ſneezing, may ſometimes free the phrenic nerves from any ſpaſm they occaſion; ſo that ſneezing ſometimes takes away the hiccough; and a derivation of the fluid of the nerves any other way may do the ſame thing: Or the hiccough may alſo be ſometimes cured, by drawing up into the noſe the ſmoak of burning paper or other acrid fumes, ſwallowing pungent or aromatic medicines, and by a ſurpriſe, or any other ſtrong application of the mind in thinking, or in diſtinguiſhing objects: Or, when all theſe have failed, it has been put away by the briſk *ſtimulus* of a bliſtering plaiſter applied to the back.

The

The *FOURTH CERVICAL* nerve, after ſending off that branch which joins with the third to form the phrenic, and beſtowing twigs on the muſcles and glands of the neck, runs to the arm-pit, where it meets with the *FIFTH*, *SIXTH*, and *SEVENTH* cervicals, and *FIRST DORSAL*, that eſcape in the interſtices of the *muſculi ſcaleni*, to come at the arm-pit, where they join, ſeparate, and rejoin, in a way ſcarce to be rightly expreſſed in words; and, after giving ſeveral conſiderable nerves to the muſcles and teguments which cover the *thorax*, they divide into ſeveral branches, to be diſtributed to all the parts of the ſuperior extremity. Seven of theſe branches I ſhall deſcribe under particular names.

1. *SCAPULARIS* runs ſtreight to the *cavitas ſemilunata* of the upper *coſta* of the *ſcapula*, which is a hole in the recent ſubject by a ligament being extended from one angle of the bone to the other, giving nerves in its way to the muſcles of the *ſcapula*. When it has paſſed this hole, it ſupplies the *ſupra ſpinatus* muſcle; and then deſcending at the anterior root of the *ſpine* of the *ſcapula*, it is loſt in the other muſcles that lie on the *dorſum* of that bone.

2. *ARTICULARIS* ſinks downwards at the *axilla*, to get below the neck of the head of the *os humeri*, and to mount again at the back-part of it; ſo that it almoſt ſurrounds the articulation, and is diſtributed to the muſcles that draw the arm back, and to thoſe that raiſe it up.

3. *CUTA-*

3. *CUTANEUS* runs down the fore-part of the arm near the ſkin, to which it gives off branches; and then divides on the inſide of the fore-arm into ſeveral nerves, which ſupply the teguments there, and on the palm of the hand.——In opening the baſilic vein of the arm, at the ordinary place, the ſame ſymptoms are ſometimes produced as in opening the external jugular vein, and from a like cauſe, to wit, from hurting a branch of this cutaneous nerve with the lancet.

4. *MUSCULO-CUTANEUS*, or *perforans Caſſeri*, paſſes through the *coracobrachialis* muſcle; and, after ſupplying the *biceps flexor cubiti* and *brachiæus internus*, paſſes behind the tendons of the *biceps*, and over the cephalic vein, to be beſtowed on the teguments on the outſide of the fore-arm and back of the hand.—This nerve is ſometimes hurt in opening the cephalic vein, and cauſes pain and numbneſs for a ſhort time.

5. *MUSCULARIS* has a ſpiral courſe from the *axilla*, under the *os humeri*, and backward to the external part of that bone, ſupplying by the way the extenſor muſcles of the fore-arm, to which it runs between the two *brachiæi* muſcles, and within the *ſupinator radii longus*.——At the upper part of the fore-arm, it ſends off a branch, which accompanies the *ſupinator longus* till it comes near the wriſt, where it paſſes obliquely over the *radius*, to be loſt in the back of the hand and fingers.—The principal part of this nerve pierces through the *ſupinator radii brevis*, to ſerve

ſerve the muſcles that extend the hand and fingers, whoſe actions are not injured when the *ſupinator* acts.

6. *ULNARIS* is extended along the inſide of the arm, to give nerves to the muſcles that extend the fore-arm to the teguments of the elbow: Towards the lower part of the arm, it ſlants a little backward to come at the groove behind the internal condyle of the *os humeri*, through which it runs to the *ulna*. In its courſe along this bone, it ſerves the neighbouring muſcles and teguments; and as it comes near the wriſt, it detaches a branch obliquely over the *ulna* to the back of the hand, to be loſt in the convex part of ſeveral fingers. The larger part of the nerve goes ſtraight forward to the internal ſide of the *os piſiforme* of the wriſt; where it ſends off a branch which ſinks under the large tendons in the palm, to go croſs to the other ſide of the wriſt, ſerving the *muſculi lumbricales* and *interoſſei*, and at laſt terminating in the ſhort muſcles of the thumb and fore-finger. What remains of the ulnar nerve after ſupplying the ſhort muſcles of the little-finger, divides into three branches; whereof two are extended along the ſides of the ſheath of the tendons of the flexors of the little-finger, to furniſh the concave ſide of that finger; and the third branch is diſpoſed in the ſame way upon the ſide of the ring-finger next to the little finger.

When we lean or preſs on the internal condyle of the *os humeri*, the numbneſs and prickling

prickling we frequently feel, point out the courſe of this nerve. I have ſeen a weakneſs and atrophy in the parts which I mentioned this nerve to be ſent to, after a wound in the internal lower part of the arm.

7. *RADIALIS* accompanies the humeral artery to the bending of the elbow, ſerving the flexors of the cubit in its way; then paſſing through the *pronator radii teres* muſcle, it gives nerves to the muſcles on the fore-part of the fore-arm, and continues its courſe near to the *radius*, beſtowing branches on the circumjacent muſcles. Near the wriſt, it ſometimes gives off a nerve which is diſtributed to the back of the hand, and the convex part of the thumb and ſeveral of the fingers, inſtead of the branch of the muſcular. The larger part of this nerve, paſſing behind the annular ligament of the wriſt, gives nerves to the ſhort muſcles of the thumb; and afterwards ſends a branch along each ſide of the ſheath of the tendons of the flexors of the thumb, fore-finger, mid-finger, and one branch to the ſide of the ring-finger, next to the middle one, to be loſt on the concave ſide of thoſe fingers.

Though the radial nerve paſſes through the *pronator* muſcle, and the *muſcular* nerve ſeems to be ſtill more unfavourably placed within the *ſupinator brevis*; yet the action of theſe muſcles don't ſeem to have any effect in hindering the influence of theſe nerves, for the fingers or hand can be bended while pronation is performing vigorouſly, and they can be extended while ſupination is exerciſed.

The

The manner of the going off of theſe nerves of the fingers, both from the *ulnar* and *radial* is, that a ſingle branch is ſent from the trunk to the ſide of the thumb and little-finger fartheſt from the other fingers; and all the reſt are ſupplied by the trunk of a nerve, which ſplits into two ſome way before it comes as far as the end of the *metacarpus*, to run along the ſides of different fingers that are neareſt to each other.

It might have been obſerved, that, in deſcribing the poſterior branches of the *ulnar* and *muſcular nerve*, I did not mention the particular fingers to the convex part of which they are diſtributed. My reaſon for this omiſſion is, the uncertainty of their diſtribution; for though ſometimes thoſe poſterior branches go to the ſame fingers, to the concave part of which the anterior branches of the *ulnar* and *radial* are ſent, yet frequently they are diſtributed otherwiſe.

The ſituation of theſe brachial nerves in the *axilla*, may let us ſee, how a weakneſs and atrophy may be brought on the arms by long continued preſſure of crutches, or ſuch other hard ſubſtances on this part; and the courſe of them from the neck to the arm may teach us, how much better effects veſicatories, or ſtimulating nervous medicines, would have, when applied to the ſkin, covering the tranſverſe proceſſes of the *vertebræ* of the neck, or at the *axilla*, than when they are put between the ſhoulders, or upon the ſpinal proceſſes, in convulſions or palſies of the ſuperior extremities, where a *ſtimulus* is required.

The *TWELVE DORSAL* nerves of each ſide, as ſoon as they eſcape from between the *vertebræ*, ſend a branch forward to join the intercoſtal, by which a communication is made among them all; and they ſoon likewiſe give branches backwards to the muſcles that raiſe the trunk of the body, their principal trunk being extended outwards to come at the furrow in the lower edge of each rib, in which they run toward the anterior part of the *thorax*, between the internal and external intercoſtal muſcles, giving off branches in their courſe to the muſcles and teguments of the *thorax*.

The *FIRST* dorſal, as was already obſerved, is particular in this, that it contributes to form the brachial nerves; and that the two branches of the intercoſtal, which come down to the *thorax*, form a conſiderable ganglion with it.

The *SIX* lower dorſal nerves give branches to the diaphragm and abdominal muſcles.

The *TWELFTH* joins with the firſt lumbar, and beſtows nerves on the *muſculus quadratus lumborum* and *iliacus internus*.

May not the communications of all theſe nerves be one reaſon, why the parts they ſerve act ſo uniformly and conjunctly in reſpiration, and conſpire together in the convulſive motions of coughing, ſneezing, *&c.*? ——The twitching ſpaſms that happen ſometimes in different parts of the muſcles of the *abdomen*, by an irritation on the branches of the lower dorſal nerves, are in danger of occaſioning a miſtake in practice, by their reſemblance to the colick, *nephritis*, *&c.*——

The

The communications of theſe lower ones with the intercoſtals, may ſerve to explain the violent effort of the abdominal muſcles in a *teneſmus* and in child-bearing.

As the intercoſtal is larger in the *thorax* than any where elſe, and ſeems to diminiſh gradually as it aſcends and deſcends, there is cauſe to ſuſpect that this is the trunk from which the ſuperior and inferior pairs are ſent as branches.

The *FIVE LUMBAR* nerves on each ſide communicate with the intercoſtal and with each other, and give branches backwards to the loins.

The *FIRST* communicates with the laſt dorſal, ſends branches to the abdominal muſcles, to the *pſoas* and *iliacus*, and to the teguments and muſcles on the fore-part of the thigh; while its principal branch joins with the other nerves, to form the crural nerve.

The *SECOND LUMBAR* nerve paſſes through the *pſoas muſcle*, and is diſtributed nearly in the ſame way as the former; as is alſo the *THIRD*.

Branches of the *ſecond*, *third*, and *fourth*, make up one trunk, which runs along the fore-part of the *pelvis*; and paſſing in the notch at the fore-part of the great hole common to the *os pubis* and *iſchium*, is ſpent on the *abductor* muſcles, and on the teguments on the inſide of the thigh. This nerve is called the *OBTURATOR* or *POSTERIOR CRURAL NERVE*.

By united branches from the *firſt*, *ſecond*, *third*, and *fourth* lumbar nerves, a nerve is

formed that runs along the *pſoas* muſcle, to eſcape with the external iliac veſſels out of the *abdomen*, below the tendinous arcade of the external oblique muſcle. This nerve, which is named the *ANTERIOR CRURAL*, is diſtributed principally to the muſcles and teguments on the fore part of the thigh. A branch, however, of this nerve runs down the inſide of the leg to the upper part of the foot, keeping near to the *vena ſaphæna*; in opening of which with a lancet at the ancle, the nerve is ſometimes hurt, and occaſions ſharp pain at the time of the operation, and numbneſs afterwards.

The remainder of the fourth lumbar and the fifth join in compoſing the largeſt nerve of the body; which is ſoon to be deſcribed.

Whoever attends to the courſe of theſe lumbar nerves, and of the ſpermatic veſſels and nerves upon the *pſoas* muſcle, with the oblique paſſage of the *ureter* over that muſcle, will not be ſurpriſed, that when a ſtone is paſſing in this canal, or even when it is inflamed, the trunk of the body cannot be raiſed erect, without great pain; or that the ſkin of the thigh becomes leſs ſenſible, and the thigh is drawn forward, and that the teſticle often ſwells, and is drawn convulſively towards the ring of the abdominal muſcles.

The *SIXTH PAIR* of the falſe *VERTEBRÆ* conſiſt each of ſmall poſterior branches ſent to the hips, and of large anterior branches.

The *firſt*, *ſecond*, and *third*, after coming through the three upper holes in the fore-

part

part of the *os ſacrum*, join together with the fourth and fifth of the loins, to form the largeſt nerve of the body, which is well known by the name of *SCIATIC* or *ISCHIATIC* nerve: This, after ſending large nerves to the different parts of the *pelvis*, and to the external parts of generation and the *podex*, as alſo to the muſcles of the hips, paſſes behind the great *tuber* of the *os iſchium*, and then over the *quadrigemini* muſcles to run down near to the bone of the thigh at its back-part, giving off nerves to the neighbouring muſcles and teguments. Some way above the ham, where it has the name of the *poplitæus* nerve, it ſends off a large branch that paſſes over the *fibula*, and ſinking in among the muſcles on the anterior external part of the leg, runs down to the foot, to be loſt in the upper part of the larger toes, ſupplying the neighbouring muſcles and teguments every where in its paſſage. The larger branch of the *ſciatic*, after giving branches to the muſcles and teguments about the ham and knee, and ſending a large cutaneous nerve down the calf of the leg, to be loſt at laſt on the outſide of the foot and upper part of the leſſer toes, ſinks below the *gemellus* muſcle, and diſtributes nerves to the muſcles on the back of the leg; among which it continues its courſe, till paſſing behind the internal *malleolus*, and in the internal hollow of the *os calcis*, it divides into the two plantar nerves: The internal of which is diſtributed to the toes in the ſame manner that the *radial* nerve of the hand ſerves the concave ſide of the thumb and fingers; and the external *plan-*

tar is divided and diſtributed to the ſole of the foot and toes, nearly as the *ulnar* nerve is in the palm of the hand, and in the concave part of the fingers.

Several branches of theſe nerves, that ſerve the *inferior extremities*, pierce through muſcles.

By applying what was ſaid of the nerves in general to the particular diſtribution of the nerves of the *inferior extremities*, we may ſee how people with fractured legs, eſpecially where there are ſplinters, ſhould be ſubject to convulſive ſtartings of the fractured member.——Why, upon tying the blood-veſſels in an amputation of the leg, the patients ſhould ſometimes complain of violent pain in their toes;——why ſuch patients ſhould alſo be troubled with ſtartings;——why, for a conſiderable time after the amputation of the diſeaſed limb, when the ſuppuration is well advanced, they ſhould complain of pain in the ſore which occaſioned the amputation.

The *FOURTH*, which, with the two following, is much ſmaller than the three ſuperior, ſoon is loſt in the *veſica urinaria* and *inteſtinum rectum*.

The *FIFTH* comes forward between the extremity of the *os ſacrum* and *coccygis*, to be diſtributed principally to the *levatores ani*.

The *SIXTH*, which ſome think to be only a production of the *dura mater*, advances forward below the broad ſhoulders of the firſt bone of the *os coccygis*, and is loſt in the *ſphincter ani* and teguments covering it.

The

The branches of the four laſt cervical nerves, and of the firſt dorſal, which are beſtowed on the *ſuperior extremities*, and the two crurals, with the ſciatic, which are diſtributed to the *inferior extremities*, are much larger proportionally to the parts they ſerve, than the nerves of the trunk of the body, and eſpecially of the *viſcera*, are; and for a very good reaſon, that in the moſt common neceſſary actions of life, a ſufficient quantity of fluid, on which the influence of nerves ſeems to depend, may be ſupplied to the muſcles there, which are obliged to perform more frequent and violent contractions than any other parts do.——The ſize of the nerves of the *inferior extremities* ſeem larger proportionally than in the *ſuperior extremities*; the *inferior extremities* having the weight of the whole body to ſuſtain, and that frequently at a great diſadvantage.——What the effect is of the nerves here being injured, we ſee daily, when people happen, by ſitting wrong, to compreſs the ſciatic nerve, they are incapable for ſome time after to ſupport themſelves on the affected *extremity*: And this is ſtill more remarkable in the *ſciatic* or *hip-gout*, in which the member is not only weakened, but gradually ſhrivels and waſtes.

THE

THE

DESCRIPTION

Of the HUMAN

LACTEAL SAC AND DUCT.

THE *receptaculum chyli* of *Pecquet*, or *ſaccus lacteus* of *Van Horne*, is a membranous ſomewhat pyriform bag, two thirds of an inch long, one third of an inch over in its largeſt part when collapſed: ſituated on the firſt *vertebra* of the loins to the right of the *aorta*, a little higher than the right emulgent artery, behind the right inferior muſcle of the diaphragm: it is formed by the union of three tubes, one from under the *aorta*, the ſecond from the interſtice of the *aorta* and *cava*, the third from under the emulgents of the right ſide. The *lacteal ſac*, becoming gradually ſmaller towards its upper part, is contracted into a ſlender membranous pipe, of about a line

line diameter, which is generally named the *THORACIC DUCT*. This paſſes betwixt the muſcular *appendices* or inferior muſcles of the diaphragm, on the right of, and ſomewhat behind the *aorta*; then, being lodged in the cellular ſubſtance behind the *pleura*, it mounts between the *aorta* and the *vena azygos* as far as the fifth *vertebra* of the *thorax*, where it is hid by the *azygos*, as this vein riſes forwards to join the deſcending or ſuperior *cava*; after which the duct paſſes obliquely over to the left ſide behind the *œſophagus*, *aorta deſcendens*, and the great curvature of the *aorta*, until it reaches the left carotid artery; behind which, on the left ſide of the *œſophagus*, it runs to the interſtice of the firſt and ſecond *vertebra* of the *thorax*, where it begins to ſeparate from the carotid, ſtretching farther towards the left internal jugular vein by a circular turn, whoſe convex part is uppermoſt. At the top of this arch it ſplits into two for a line and an half; the ſuperior branch receiving into it a large lymphatic veſſel from the cervical glands. This lymphatic appears, by blowing air and injecting liquors into it, to have few valves. When the two branches are again united, the duct continues its courſe towards the internal jugular vein, behind which it deſcends, and, immediately at the left ſide of the inſertion of this vein, enters the ſuperior poſterior part of the left ſubclavian vein, whoſe internal membrane duplicated, forms a ſemilunar valve that is convex externally, and covers two thirds of the orifice of the duct; immediately below this orifice, a cervical vein from

from the *muſculi ſcaleni* enters the ſubclavian.

The coats of the *ſac* and *duct* are thin tranſparent membranes; from the inſide of which, in the duct, ſmall ſemilunar valves are produced, moſt commonly in pairs; which are ſo ſituated as to allow the paſſage of liquors upwards, but oppoſe their return in an oppoſite courſe. The number of theſe is generally ten or twelve.

This is the moſt ſimple and common courſe, ſituation, and ſtructure of the *receptaculum chyli* and *thoracic duct*; but having had occaſion to obſerve a variety in theſe parts, of different ſubjects, I ſhall ſet down the moſt remarkable of them.

The ſac is ſometimes ſituated lower down than in the former deſcription; is not always of the ſame dimenſions; is not compoſed of the ſame number of ducts; and frequently appears to conſiſt of ſeveral ſmall cells or ducts, inſtead of being one ſimple cavity.

The diameter of the duct is various in moſt bodies, and is ſeldom uniform in the ſame ſubject; but frequently ſudden enlargements or *ſacculi* of it are obſervable.——The diviſions which authors mention of this duct are very uncertain. I have ſeen it divided into two, whereof one branch climbed over the forepart of the *aorta* at the eighth *vertebra* of the *thorax*, and at the fifth ſlipped behind that artery, to join the other branch which continued in the ordinary courſe.——The preciſe *vertebra*, where it begins to turn to the left ſide, is alſo uncertain.——Frequently it does not

ſplit

ſplit at its ſuperior arch; in which caſe a large ſac is found near its aperture into the ſubclavian vein.—Generally it has but one orifice; though I have ſeen two in one body, and three in another: Nay, ſometimes it divides into two, under the curvature of the great artery; one goes to the right, another to the left ſubclavian vein; and I have found this duct diſcharging itſelf entirely into the right ſubclavian.—The lymphatic veſſel which enters its ſuperior arch, is often ſent from the *thyroid* gland.

Whether is not the ſituation of the *receptaculum chyli* ſo much nearer the muſcular *appendices* of the diaphragm in men than in brutes, deſigned to ſupply the diſadvantageous courſe the chyle muſt otherwiſe have in our erect poſture?

Does not the deſcent of the end of the duct to the ſubclavian vein, and the opening of the lymphatic into the top of the arch, contribute to the ready admiſſion of the chyle into that vein?

F I N I S.

Belvedere